Hazen

FIESTA VILLAGE WRF SLUDGE DEWATERING AND SODIUM HYPOCHLORITE SYSTEM IMPROVEMENTS

TECHNICAL SPECIFICATIONS

February, 2019

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SECTION 01010

SUMMARY OF WORK

PART 1 -- GENERAL

1.01 GENERAL

A. The Work to be performed under this Contract shall consist of furnishing all tools, equipment, materials, supplies, and manufactured articles and for furnishing all transportation and services, including fuel, power, water, and essential communications, and for the performance of all labor, work, or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents. The Work shall be complete, and all work, materials, and services not expressly shown or called for in the Contract Documents which may be necessary for the complete and proper construction of the Work in good faith shall be performed, furnished, and installed by the Contractor as though originally so specified or shown, at no increase in cost to the County.

B. The term “Owner” shall be defined as the Lee County Utilities (LCU), its agents and authorized representatives. The term “Engineer” shall be defined as the Engineer-of – Record for this project which is Hazen and Sawyer, P.C. The site where the work is to take place is the LCU’s Fiesta Village Wastewater Reclamation Facility (WRF), herein referred to as the WRF or FVWRF.

C. Prior to construction, the Contractor shall verify existing utilities identified on the Drawings. The utility verifications consist of excavation to verify tie-in points and to locate potential conflicts that may affect the work as shown on the Drawings. The Contractor will be responsible for the coordination of this work with the associated utility owners and permitting agencies having jurisdiction over the specific locations to be verified.

C. The Contractor shall be responsible for and perform all Work, whether by self-performance or by subcontract to qualified entities, as required for such construction in accordance with the Contract Documents and subject to the terms and conditions of the Contract, complete and ready for use. Wherever the Contract Documents address a third party, i.e., subcontractor, manufacturer, etc., it is to be considered as the Contractor through the third party.

1.02 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work set forth within these bid documents includes the furnishing of all labor, materials, equipment, services and incidentals for:

- One new high solids centrifuge and all appurtenances on a new concrete platform.
- Dewatered cake conveyance including automated truck loading system

- Centrate piping, floor drain piping, and new manholes to connect to existing site gravity sewer system. Replacement of the two existing Centrate LS submersible pumps with two new pumps.
- Digested sludge feed pumps on a new concrete pad, and associated valves and piping, digested sludge flow meter, and associated electrical and control components. Includes modifications to the existing digested sludge piping.
- Polymer storage and make up units along with dilute polymer feed piping and injection points.
- Reclaimed water piping to provide dilution water for the polymer make up units, digested sludge feed pumps, and centrifuge. Reclaimed water piping to supply new hose bibs.
- Dewatering area concrete slab, access drive, stormwater and site improvements
- Pre-engineered metal building canopy to be installed on top of the concrete platform for the new dewatering equipment incorporating a new bridge crane, LED lighting, and video monitoring system
- Pre-cast concrete electrical/control building for dewatering system equipment powered from the plant's existing electrical system and connected to the plant's existing backup emergency generator system.
- Associated piping, electrical and control system improvements for dewatering system
- Two Sodium hypochlorite storage tanks on a new concrete pad with containment
- Two Sodium hypochlorite feed pumps and feed piping (sized to match existing)
- Pre-engineered canopy structure for the new sodium hypochlorite storage and feed equipment
- Associated piping, electrical and control system improvements for sodium hypochlorite system

C. All materials and workmanship supplied for this project shall be of first class quality.

1.03 CONTRACT DOCUMENTS

A. The term "Contract Documents" refers to the entire set of Bid Proposal, Agreement, General Conditions, Supplementary Conditions, Technical Specifications and Drawings issued at the time of the bid along with any modifications of the bid documents by way of official addendum issued prior to bid opening.

B. The Drawings included in the Contract Documents are entitled "Fiesta Village WRF Sludge Dewatering and Sodium Hypochlorite Storage Tank Improvements". The numbers and titles of all Drawings appear on the index sheet of the Drawings on the Cover Sheet. All drawings so enumerated shall be considered an integral part of the

Contract Documents as defined herein. Supplemental drawings developed during construction as may be required to be submitted by the Contractor per the specifications shall also be considered a part of the Contract Documents, along with all supplemental drawings issued as part of the response to requests for information (RFIs) during construction or as approved by change order during construction.

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D. Contractor shall perform the work in accordance with the Contract Documents, and in accordance with applicable local and national building codes. Where there is an apparent discrepancy between the Drawings, Specifications, or any local and/or national codes, the more stringent of the requirements shall apply unless otherwise approved by the Engineer.

1.04 GENERAL ARRANGEMENT

A. Drawings indicate the extent and general arrangement of the Work. If any departures from the Drawings are deemed necessary by the Contractor to accommodate the materials and equipment he proposes to furnish, details of such departures and reasons therefore shall be submitted as soon as practicable to the Owner for approval. No such departures shall be made without the prior written approval of the Owner. Approved changes shall be made without additional cost to the Owner for this Work or related Work under other Contracts of the Project.

B. The specific equipment proposed for use by the Contractor on the project may require changes in structures, auxiliary equipment, piping, electrical, mechanical, controls or other Work to provide a complete satisfactory operating installation. The Contractor shall submit to the Owner, for approval, all necessary drawings and details showing such changes to verify conformance with the overall project requirements and overall project operating performance. All costs in connection with the preparation of supplemental drawings and details and all changes to construction Work to accommodate the proposed equipment, including increases in the costs of other Contracts, shall be borne by the Contractor.

1.05 CONSTRUCTION PERMITS, EASEMENTS AND ENCROACHMENTS

A. The Contractor shall obtain, keep current and pay all fees for any necessary construction permits from those authorities, agencies, or municipalities having jurisdiction over land areas, utilities, or structures which are located within the Contract limits and which will be occupied, encountered, used, or temporarily interrupted by the

Contractor's operations unless otherwise stated. Record copies of all permits shall be furnished to the Owner.

B. When construction permits are accompanied by regulations or requirements issued by a particular authority, agency or municipality, it shall be the Contractor's responsibility to familiarize himself and comply with such regulations or requirements as they apply to his operations on this Project.

C. Applicable building permits shall be obtained by the Contractor. The Contractor shall pull, pay for, obtain, and comply with all required trade permits based on the Conformed Documents provided to the Contractor. Payment for building permits will be reimbursed to the Contractor through the Permit Allowance included in the bid. Copies of invoices for permit payment shall be submitted with the pay application to be considered for reimbursement. Signed and sealed sets of Contract Documents for permitting agency use will be provided upon request.

D. It shall be the Contractor's responsibility to secure all permits required to initiate and complete the work under this contract not already obtained by the County. The County has obtained the necessary FDEP construction permit and ERP permit for the project. The Contractor is responsible for complying with all conditions of these permits. The Contractor is to obtain the necessary NPDES permit for construction ground water dewatering activities.

E. The Contractor shall provide any required Performance and Indemnity Bond(s).

1.06 ADDITIONAL ENGINEERING SERVICES

A. In the event that the Engineer is required to provide additional engineering services as a result of substitution of materials or equipment which are not "or equal" by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the Engineer is required to examine and evaluate any changes proposed by the Contractor for the convenience of the Contractor, then the Engineer's charges in connection with such additional services shall be charged to the Contractor by the Owner.

B. Structural design shown on the Contract Drawings is based upon typical weights and resonance frequencies for rotating equipment for major items of equipment as indicated on the Contract Drawings and specified. If the equipment furnished differs from that specified in the Contract Documents such that actual weight or resonance frequencies exceeds the limits of specified equipment, the Contractor shall assume the responsibility for all costs of redesign and for any construction changes required to accommodate the equipment furnished, including the Engineer's expenses in connection therewith, provided that the original weight assumptions were correct.

C. In the event that the Engineer is required to provide additional engineering services as a result of Contractor's errors, omissions, or failure to conform to the requirements of the Contract Documents, or if the Engineer is required to examine and evaluate any changes proposed by the Contractor solely for the convenience of the Contractor, then

the Engineer's charges in connection with such additional services shall be charged to the Contractor by the Owner.

1.07 ADDITIONAL OWNER'S EXPENSES

A. In the event the Work of this Contract is not completed within the time set forth in the Contract or within the time to which such completion may have been extended in accordance with the Contract Documents, the additional engineering or inspection charges incurred by the Owner may be charged to the Contractor and deducted from the monies due him. Extra Work or supplemental Contract Work added to the original Contract, as well as extenuating circumstances beyond the control of the Contractor, will be given due consideration by the Owner before assessing engineering and inspection charges against the Contractor.

B. Unless otherwise specifically approved, the normal time of Work under this Contract is limited to nine (9) hours per day, Monday through Friday, excluding County holidays, generally be between the hours of 8:00 a.m. and 5:00 p.m. unless otherwise approved by the County. The County generally accepts revised work hours on week days from 7:00 a.m. to 3:00 p.m. when so requested by the Contractor. Work beyond these hours, beyond otherwise approved hours, or on weekends or holidays, will result in additional expense to the Owner. Any expenses and/or damages, including the cost of the Engineer's on site personnel, arising from the Contractor's operations beyond the hours and days specified above shall be borne by the Contractor.

C. Charges assessed to the Contractor for additional engineering and inspection costs will be determined based on actual hours charged to the job by the Engineer. Daily rates will depend on the number and classifications of employees involved, but in no case shall such charges exceed $250 per day for County inspectors based on an eight hour work day and up to $450 per day for engineer time based on 2 hours per day.

D. Charges for additional Owner's expenses shall be independent of any liquidated damages assessed in accordance with the Contract.

E. Schedule and perform the Work in such a manner as to result in the least possible disruption to the Owner’s ability to meet permit conditions for the WRF. If it becomes imperative to perform Work at night for critical shutdowns that must be done under periods of low flow, the Owner shall be informed in writing a minimum of 72 hours in advance of the beginning of such Work and the Contractor must receive written approval from the Owner for performing such work after hours. Temporary lighting and all other necessary facilities for performing and inspecting the Work shall be provided and maintained by the Contractor.

1.08 SUBSURFACE DATA

A. A copy of a geotechnical investigation report entitled “Lee County Fiesta Village WWTP Sludge Dewatering System and Hypochlorite Storage Tank Improvements” by GFA International, dated February 9, 2018 is provided at the end of this section. Subsurface data included therein are offered in good faith solely for placing the Contractor in receipt

of all information available to the Owner. The Contractor shall interpret such subsurface data according to his own judgment and acknowledge that he is not relying upon the same as accurately describing the subsurface conditions, which may be found to exist.

B. The test boring logs present factual information of the subsurface conditions at the specific test boring location only. The Contractor should not consider, or conclude, that the subsurface conditions will be consistent between test boring locations. In making this data available, the Owner makes no guarantee, either expressed or implied, as to their accuracy or to the accuracy of any interpretation thereof.

1.09 LABOR EMPLOYED

A. All labor employed by the Contractor and subcontractors for the Work shall abide by all applicable Owner labor laws for non-discrimination. The Contractor further understands and agrees that it is the Contractor's responsibility to assure that all laborers are legal US citizens or legally registered aliens of the US.

1.10 SANITARY PROVISIONS

A. Provide and maintain, in a neat and sanitary condition, such accommodations for the use of the Contractor's employees as are necessary to comply with the requirements and regulations of the State and Federal Government, committing no public nuisance. The Contractor understands and agrees that the Owner's existing facilities are not to be used by construction personnel.

1.11 CONTRACTOR'S RESPONSIBILITY FOR WORK

A. Until acceptance of the Work by the Owner, it shall be under the charge and custody of the Contractor who shall take every necessary precaution against injury or damage to the Work by the action of the elements or from any other cause whatsoever, arising either from the execution or from the non-execution of the Work. The Contractor shall protect, rebuild, repair, restore and make good, without additional compensation, all injury or damage to any portion of the Work occasioned by any cause before its completion and acceptance.

1.12 MAINTENANCE OF ACCESS AND SITE TRAFFIC

A. Provide all measures to ensure continuous, safe access for the Owner's operations and maintenance staff in the performance of their duties. Submit maintenance of personnel and vehicular access and traffic patterns when it is necessary to close normal paths of access or traffic within the plant site. Contractor's actions shall make no disruption of public roadway traffic at any time.

1.13 NOISE AND DUST CONTROL

A. Eliminate noise within the project area to the extent possible. "Residential" type mufflers shall be installed on all gasoline and diesel engines. All local ordinances and regulations covering noise control shall be observed.

B. Control dust emissions at all times through appropriate construction techniques, containment of dust to confined areas of the work, and by regular wetting of unpaved temporary construction access ways during dry weather.

1.14 STORAGE

A. Storage conditions shall be acceptable to Owner for all materials and equipment not immediately incorporated into the Work but included in Applications for Payment. Such storage arrangements and conditions shall be presented in writing for Owner's review and approval and shall afford adequate and satisfactory security and protection. Off-site storage facilities shall be accessible for inspection. The stored materials shall be insured for full value. Certificates of liability insurance coverage must be submitted to the Owner with the request for payment. All arrangements and costs for storage facilities shall be paid by the Conctractor.

B. The Contractor may utilize the staging area shown on the Drawings within the limits of the site for location of office facilities, storage of materials and equipment, and as a staging area. The staging area shall be finished graded, seeded, and a healthy stand of grass established upon completion of the Work at no additional cost to the Owner.

1.14 FIRE PROTECTION

A. Contractor shall take all necessary precautions to prevent fires at or adjacent to the Work, buildings, etc., and shall provide adequate facilities for extinguishing fires which do occur. Open fires shall not be permitted.

B. When fire or explosion hazards are created in the vicinity of the Work as a result of the locations of fuel tanks, or similar hazardous utilities or devices, the Contractor shall immediately alert the local Fire Marshal and the Owner of such tank or device. The Contractor shall exercise all safety precautions and shall comply with all instructions issued by the Fire Marshal and shall cooperate with the Owner of the tank or device to prevent the occurrence of fire or explosion.

1.15 CHEMICALS

A. All chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, or reactant of other classification, must show approval of either the EPA or USDA. Use of all such chemicals and disposal of residues shall be in strict conformance with all applicable rules and regulations.

1.16 FIRST AID FACILITIES AND ACCIDENTS

A. First Aid Facilities: The Contractor shall provide at the site such equipment and facilities as are necessary to supply first aid to any of his personnel who may be injured in connection with the Work.

B. Accidents

1. The Contractor shall promptly report, in writing, to the Owner all accidents whatsoever out of, or in connection with, the performance of the Work, whether on or adjacent to the site, which cause death, personal injury or property damage, giving full details and statements of witnesses.

2. If death, serious injuries, or serious damages are caused, the accident shall be reported immediately by telephone or messenger to both the Owner.

3. If any claim is made by anyone against the Contractor or a Subcontractor on account of any accidents, the Contractor shall promptly report the facts, in writing, to the Owner, giving full details of the claim.

1.17 DISPOSITION OF CLAIMS RELATED TO OTHER CONTRACTORS

A. During the progress of the Work, other contractors may be engaged in performing other work or may be awarded other contracts for additional work on this project. In that event, the Contractor shall coordinate the Work to be done hereunder with the work of such other contractors and the Contractor shall fully cooperate with such other contractors and carefully fit its own Work to that provided under other contracts as may be directed by the Owner. The Contractor shall not commit or permit any act which will interfere with the performance of work by any other contractor.

B. If the Owner shall determine that the Contractor is failing to coordinate his Work with the work of other contractors as the Owner directed, then the Owner shall have the right to withhold any payments otherwise due hereunder until the Contractor completely complies with the Owner's directions.

C. If the Contractor notifies the Owner in writing that another contractor is failing to coordinate his work with the Work of this Contract as directed, the Owner will promptly investigate the charge. If the Owner finds it to be true, the Owner will promptly issue such directions to the other contractor with respect thereto as the situation may require and issue a response to the Contractor in writing. The Owner, nor any of the Owner’s agents, shall not be liable for any damages suffered by the Contractor by reason of the other contractor's failure to promptly comply with the directions so issued by the Owner, or by reason of another contractor's default in performance, it being understood that the Owner does not guarantee the responsibility or continued efficiency of any contractor.

D. The Contractor shall indemnify and hold the Owner harmless from any and all claims of judgments for damages and from costs and expenses to which the Owner may be subjected or which it may suffer or incur by reason of the Contractor's failure to comply with the Owner's directions promptly.

E. Should the Contractor sustain any damage through any act or omission of any other contractor having a contract with the Owner for the performance of work upon the site or of work which may be necessary to be performed for the proper execution of the Work to be performed hereunder, or through any act or omission of a subcontractor of such Contract, the Contractor shall have no claim against the Owner for such damage, but

shall have a right to recover such damage from the other contractor through other outside legal pursuits.

F. Should any other contractor having or who shall hereafter have a Contract with the Owner for the performance of work upon the site sustain any damage through any act or omission of the Contractor hereunder or through any act or omission of any subcontractor of the Contractor, the Contractor agrees to reimburse such other contractor for all such damages and to defend at his own expense any suit based upon such claim and if any judgment or claims against the Owner shall be allowed, the Contractor shall pay or satisfy such judgment or claim and pay all costs and expenses in connection therewith and shall indemnify and hold the Owner harmless from all such claims.

G. The Owner's right to indemnification hereunder shall in no way be diminished, waived or discharged, by its recourse to assessment of liquidated damages as provided in the Contract, or by the exercise of any other remedy provided for by Contract Documents or by law.

1.18 LIMITS OF WORK AREA

A. The Contractor shall confine his construction operations within the Contract limits shown on the Drawings and/or property lines and/or fence lines. Storage of equipment and materials, or erection and use of sheds outside of the Contract limits, if such areas are the property of the Owner, shall be used only with the Owner's approval. Such storage or temporary structures, even within the Contract's limits, shall be confined to the Owner's property and shall not be placed on properties designated as easements or rights-of-way unless specifically permitted elsewhere in the Contract Documents.

1.19 WEATHER CONDITIONS

A. No Work shall be done when the weather is unsuitable. The Contractor shall take necessary precautions (in the event of impending severe weather, including hurricanes, tropical storms or major rain/wind storms) to protect all Work, materials, or equipment from damage or deterioration due to floods, driving rain, and/or wind. The Owner reserves the right, to order that additional protection measures over and beyond those proposed by the Contractor, be taken to safeguard all components of the Project.

B. The mixing and placing of concrete or pavement courses, the laying of masonry, and installation of sewers and water mains shall be stopped during rainstorms, and all freshly placed Work shall be protected by canvas or other suitable covering in such manner as to prevent running water from coming in contact with it. Sufficient coverings shall be provided and kept ready at hand for this purpose. The limitations and requirements for mixing and placing concrete, or laying of masonry, in cold weather shall be as described elsewhere in these Specifications.

1.20 PERIODIC CLEANUP: BASIC SITE RESTORATION

A. During construction, the Contractor shall regularly remove from the site of the Work all accumulated debris and surplus materials of any kind which result from his operations.

Unused equipment and tools shall be stored at the Contractor's yard or base of operations for the Project.

B. When the Work involves installation of sewers, drains, water mains, manholes, underground structures, or other disturbance of existing features in or across access roads and paths, driveways, public streets, rights-of-way, easements, or private property, the Contractor shall (as the Work progresses) promptly backfill, compact, grade, and otherwise restore the disturbed area to the basic condition which will permit resumption of pedestrian or vehicular traffic and any other critical activity or functions consistent with the original use of the land. The requirements for temporary paving of streets, walks, and driveways are specified elsewhere. Unsightly mounds of earth, large stones, boulders, and debris shall be removed so that the site presents a neat appearance.

C. The Contractor shall perform the cleanup Work on a regular basis and as frequently as ordered by the Owner. Basic site restoration in a particular area shall be accomplished immediately following the installation or completion of the required facilities in that area. Furthermore, such Work shall also be accomplished, when ordered by the Owner, if partially completed facilities must remain incomplete for some time period due to unforeseen circumstances.

D. Upon failure of the Contractor to perform periodic cleanup and basic restoration of the site to the Owner's satisfaction, the Owner may, upon five days prior written notice to the Contractor, without prejudice to any other rights or remedies of the Owner, cause such Work for which the Contractor is responsible to be accomplished to the extent deemed necessary by the Owner, and all costs resulting therefrom shall be charged to the Contractor and deducted from the amounts of money that may be due him.

1.21 USE OF FACILITIES BEFORE COMPLETION

A. The Owner reserves the right to enter and use any portion of the constructed facilities before final completion of the whole Work to be done under this Contract. However, only those portions of the facilities which have been completed to the Owner's satisfaction, as evidenced by his issuing a Certificate of Substantial Completion to the Contractor covering that part of the Work, shall be placed in service.

B. It shall be the Contractor's responsibility to prevent premature connections to or use of any portion of the installed facilities before the Owner issues a Certificate of Substantial Completion covering that portion of the Work to be placed in service.

C. Consistent with the approved progress schedule, the Contractor shall cooperate with the Owner to accelerate completion of those facilities, or portions thereof, which have been designated for early use by the Owner.

D. The Contractor shall ensure that smoking on County property is strictly prohibited by all employees and all employees of subcontractors during the full extent of the project.

1.22 WORK PLANNING FOR CRITICAL FUNCTIONS

A. When the work involves requests for after-hours work, interruption of operations of any kind, demolition of any kind, tie-ins to existing processes and piping, and/or training events, written notice shall be given to the County in the form of a detailed work plan a minimum of 3 calendar days prior to the early start date for the work being considered.

B. In as much as possible, such critical work functions shall be identified and brought up a the progress meeting preceding the need for such work.

C. The County will have final approval on the details, timing, and scheduling of all such work to best avoid any potential for non-compliance of permit conditions and to assure adequate County personnel are available as needed.

1.23 SITE CONDITIONS

A. The Contractor acknowledges that he has investigated prior to bidding and satisfied himself as to the conditions affecting the Work, including but not restricted to those bearing upon transportation, disposal, handling and storage of materials, availability of labor, water, electric power, roads and uncertainties of weather, river stages, tides, water tables or similar physical conditions at the site, the conformation and conditions of the ground, the character of equipment and facilities needed preliminary to and during prosecution of the Work. The Contractor further acknowledges that he has satisfied himself as to the character, quality and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, or any contiguous site, as well as from information presented by the Drawings and Specifications made a part of this Contract, or any other information made available to him prior to receipt of Bids. Any failure by the Contractor to acquaint himself with the available information will not relieve him from responsibility for estimating properly the difficulty or cost of successfully performing the Work. The County assumes no responsibility for any conclusions or interpretations made by the Contractor on the basis of the information made available by the County.

1.24 DIFFERING SITE CONDITIONS

A. The Contractor shall promptly and before such conditions are disturbed, notify the County in writing of: (1) subsurface or latent physical conditions at the site differing materially from those indicated in this contract, or (2) unknown physical conditions at the site, of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for this contract. The County will promptly investigate the conditions, and if he finds that such conditions do materially so differ and cause an increase or decrease in the Contractor's cost of, or the time required for, performance of any part of the work under this contract, whether or not changed as a result of such conditions, an equitable adjustment shall be made and the contract modified in writing accordingly.

B. No claim of the Contractor under this clause shall be allowed unless the Contractor has given the notice required in Paragraph A.

C. No claim by the Contractor for an equitable adjustment hereunder shall be allowed if asserted after final payment under this contract.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION –

SECTION 01010

SUMMARY OF WORK

PART 1 -- GENERAL

1.01 GENERAL

A. The Work to be performed under this Contract shall consist of furnishing all tools, equipment, materials, supplies, and manufactured articles and for furnishing all transportation and services, including fuel, power, water, and essential communications, and for the performance of all labor, work, or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents. The Work shall be complete, and all work, materials, and services not expressly shown or called for in the Contract Documents which may be necessary for the complete and proper construction of the Work in good faith shall be performed, furnished, and installed by the Contractor as though originally so specified or shown, at no increase in cost to the County.

B. The term “Owner” shall be defined as the Lee County Utilities (LCU), its agents and authorized representatives. The term “Engineer” shall be defined as the Engineer-of – Record for this project which is Hazen and Sawyer, P.C. The site where the work is to take place is the LCU’s Fiesta Village Wastewater Reclamation Facility (WRF), herein referred to as the WRF or FVWRF.

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B. The specific equipment proposed for use by the Contractor on the project may require changes in structures, auxiliary equipment, piping, electrical, mechanical, controls or other Work to provide a complete satisfactory operating installation. The Contractor shall submit to the Owner, for approval, all necessary drawings and details showing such changes to verify conformance with the overall project requirements and overall project operating performance. All costs in connection with the preparation of supplemental drawings and details and all changes to construction Work to accommodate the proposed equipment, including increases in the costs of other Contracts, shall be borne by the Contractor.

1.05 CONSTRUCTION PERMITS, EASEMENTS AND ENCROACHMENTS

A. The Contractor shall obtain, keep current and pay all fees for any necessary construction permits from those authorities, agencies, or municipalities having jurisdiction over land areas, utilities, or structures which are located within the Contract limits and which will be occupied, encountered, used, or temporarily interrupted by the Contractor's operations unless otherwise stated. Record copies of all permits shall be furnished to the Owner.

B. When construction permits are accompanied by regulations or requirements issued by a particular authority, agency or municipality, it shall be the Contractor's responsibility to familiarize himself and comply with such regulations or requirements as they apply to his operations on this Project.

C. Applicable building permits shall be obtained by the Contractor. The Contractor shall pull, pay for, obtain, and comply with all required trade permits based on the Conformed

Documents provided to the Contractor. Payment for building permits will be reimbursed to the Contractor through the Permit Allowance included in the bid. Copies of invoices for permit payment shall be submitted with the pay application to be considered for reimbursement. Signed and sealed sets of Contract Documents for permitting agency use will be provided upon request.

D. It shall be the Contractor's responsibility to secure all permits required to initiate and complete the work under this contract not already obtained by the County. The County has obtained the necessary FDEP construction permit and ERP permit for the project. The Contractor is responsible for complying with all conditions of these permits. The Contractor is to obtain the necessary NPDES permit for construction ground water dewatering activities.

E. The Contractor shall provide any required Performance and Indemnity Bond(s).

1.06 ADDITIONAL ENGINEERING SERVICES

A. In the event that the Engineer is required to provide additional engineering services as a result of substitution of materials or equipment which are not "or equal" by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the Engineer is required to examine and evaluate any changes proposed by the Contractor for the convenience of the Contractor, then the Engineer's charges in connection with such additional services shall be charged to the Contractor by the Owner.

B. Structural design shown on the Contract Drawings is based upon typical weights and resonance frequencies for rotating equipment for major items of equipment as indicated on the Contract Drawings and specified. If the equipment furnished differs from that specified in the Contract Documents such that actual weight or resonance frequencies exceeds the limits of specified equipment, the Contractor shall assume the responsibility for all costs of redesign and for any construction changes required to accommodate the equipment furnished, including the Engineer's expenses in connection therewith, provided that the original weight assumptions were correct.

C. In the event that the Engineer is required to provide additional engineering services as a result of Contractor's errors, omissions, or failure to conform to the requirements of the Contract Documents, or if the Engineer is required to examine and evaluate any changes proposed by the Contractor solely for the convenience of the Contractor, then the Engineer's charges in connection with such additional services shall be charged to the Contractor by the Owner.

1.07 ADDITIONAL OWNER'S EXPENSES

A. In the event the Work of this Contract is not completed within the time set forth in the Contract or within the time to which such completion may have been extended in accordance with the Contract Documents, the additional engineering or inspection charges incurred by the Owner may be charged to the Contractor and deducted from the monies due him. Extra Work or supplemental Contract Work added to the original Contract, as well as extenuating circumstances beyond the control of the Contractor, will be given due

consideration by the Owner before assessing engineering and inspection charges against the Contractor.

B. Unless otherwise specifically approved, the normal time of Work under this Contract is limited to nine (9) hours per day, Monday through Friday, excluding County holidays, generally be between the hours of 8:00 a.m. and 5:00 p.m. unless otherwise approved by the County. The County generally accepts revised work hours on week days from 7:00 a.m. to 3:00 p.m. when so requested by the Contractor. Work beyond these hours, beyond otherwise approved hours, or on weekends or holidays, will result in additional expense to the Owner. Any expenses and/or damages, including the cost of the Engineer's on site personnel, arising from the Contractor's operations beyond the hours and days specified above shall be borne by the Contractor.

C. Charges assessed to the Contractor for additional engineering and inspection costs will be determined based on actual hours charged to the job by the Engineer. Daily rates will depend on the number and classifications of employees involved, but in no case shall such charges exceed $250 per day for County inspectors based on an eight hour work day and up to $450 per day for engineer time based on 2 hours per day.

D. Charges for additional Owner's expenses shall be independent of any liquidated damages assessed in accordance with the Contract.

E. Schedule and perform the Work in such a manner as to result in the least possible disruption to the Owner’s ability to meet permit conditions for the WRF. If it becomes imperative to perform Work at night for critical shutdowns that must be done under periods of low flow, the Owner shall be informed in writing a minimum of 72 hours in advance of the beginning of such Work and the Contractor must receive written approval from the Owner for performing such work after hours. Temporary lighting and all other necessary facilities for performing and inspecting the Work shall be provided and maintained by the Contractor.

1.08 SUBSURFACE DATA

A. A copy of a geotechnical investigation report entitled “Lee County Fiesta Village WWTP Sludge Dewatering System and Hypochlorite Storage Tank Improvements” by GFA International, dated February 9, 2018 is provided at the end of this section. Subsurface data included therein are offered in good faith solely for placing the Contractor in receipt of all information available to the Owner. The Contractor shall interpret such subsurface data according to his own judgment and acknowledge that he is not relying upon the same as accurately describing the subsurface conditions, which may be found to exist.

B. The test boring logs present factual information of the subsurface conditions at the specific test boring location only. The Contractor should not consider, or conclude, that the subsurface conditions will be consistent between test boring locations. In making this data available, the Owner makes no guarantee, either expressed or implied, as to their accuracy or to the accuracy of any interpretation thereof.

1.09 LABOR EMPLOYED

A. All labor employed by the Contractor and subcontractors for the Work shall abide by all

applicable Owner labor laws for non-discrimination. The Contractor further understands and agrees that it is the Contractor's responsibility to assure that all laborers are legal US citizens or legally registered aliens of the US.

1.10 SANITARY PROVISIONS

A. Provide and maintain, in a neat and sanitary condition, such accommodations for the use of the Contractor's employees as are necessary to comply with the requirements and regulations of the State and Federal Government, committing no public nuisance. The Contractor understands and agrees that the Owner's existing facilities are not to be used by construction personnel.

1.11 CONTRACTOR'S RESPONSIBILITY FOR WORK

A. Until acceptance of the Work by the Owner, it shall be under the charge and custody of the Contractor who shall take every necessary precaution against injury or damage to the Work by the action of the elements or from any other cause whatsoever, arising either from the execution or from the non-execution of the Work. The Contractor shall protect, rebuild, repair, restore and make good, without additional compensation, all injury or damage to any portion of the Work occasioned by any cause before its completion and acceptance.

1.12 MAINTENANCE OF ACCESS AND SITE TRAFFIC

A. Provide all measures to ensure continuous, safe access for the Owner's operations and maintenance staff in the performance of their duties. Submit maintenance of personnel and vehicular access and traffic patterns when it is necessary to close normal paths of access or traffic within the plant site. Contractor's actions shall make no disruption of public roadway traffic at any time.

1.13 NOISE AND DUST CONTROL

A. Eliminate noise within the project area to the extent possible. "Residential" type mufflers shall be installed on all gasoline and diesel engines. All local ordinances and regulations covering noise control shall be observed.

B. Control dust emissions at all times through appropriate construction techniques, containment of dust to confined areas of the work, and by regular wetting of unpaved temporary construction access ways during dry weather.

1.14 STORAGE

A. Storage conditions shall be acceptable to Owner for all materials and equipment not immediately incorporated into the Work but included in Applications for Payment. Such storage arrangements and conditions shall be presented in writing for Owner's review and approval and shall afford adequate and satisfactory security and protection. Off-site storage facilities shall be accessible for inspection. The stored materials shall be insured for full value. Certificates of liability insurance coverage must be submitted to the Owner with the request for payment. All arrangements and costs for storage facilities shall be paid by the Conctractor.

B. The Contractor may utilize the staging area shown on the Drawings within the limits of the site for location of office facilities, storage of materials and equipment, and as a staging area. The staging area shall be finished graded, seeded, and a healthy stand of grass established upon completion of the Work at no additional cost to the Owner.

1.14 FIRE PROTECTION

A. Contractor shall take all necessary precautions to prevent fires at or adjacent to the Work, buildings, etc., and shall provide adequate facilities for extinguishing fires which do occur. Open fires shall not be permitted.

B. When fire or explosion hazards are created in the vicinity of the Work as a result of the locations of fuel tanks, or similar hazardous utilities or devices, the Contractor shall immediately alert the local Fire Marshal and the Owner of such tank or device. The Contractor shall exercise all safety precautions and shall comply with all instructions issued by the Fire Marshal and shall cooperate with the Owner of the tank or device to prevent the occurrence of fire or explosion.

1.15 CHEMICALS

A. All chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, or reactant of other classification, must show approval of either the EPA or USDA. Use of all such chemicals and disposal of residues shall be in strict conformance with all applicable rules and regulations.

1.16 FIRST AID FACILITIES AND ACCIDENTS

A. First Aid Facilities: The Contractor shall provide at the site such equipment and facilities as are necessary to supply first aid to any of his personnel who may be injured in connection with the Work.

B. Accidents

1. The Contractor shall promptly report, in writing, to the Owner all accidents whatsoever out of, or in connection with, the performance of the Work, whether on or adjacent to the site, which cause death, personal injury or property damage, giving full details and statements of witnesses.

2. If death, serious injuries, or serious damages are caused, the accident shall be reported immediately by telephone or messenger to both the Owner.

3. If any claim is made by anyone against the Contractor or a Subcontractor on account of any accidents, the Contractor shall promptly report the facts, in writing, to the Owner, giving full details of the claim.

1.17 DISPOSITION OF CLAIMS RELATED TO OTHER CONTRACTORS

A. During the progress of the Work, other contractors may be engaged in performing other work or may be awarded other contracts for additional work on this project. In that event,

the Contractor shall coordinate the Work to be done hereunder with the work of such other contractors and the Contractor shall fully cooperate with such other contractors and carefully fit its own Work to that provided under other contracts as may be directed by the Owner. The Contractor shall not commit or permit any act which will interfere with the performance of work by any other contractor.

B. If the Owner shall determine that the Contractor is failing to coordinate his Work with the work of other contractors as the Owner directed, then the Owner shall have the right to withhold any payments otherwise due hereunder until the Contractor completely complies with the Owner's directions.

C. If the Contractor notifies the Owner in writing that another contractor is failing to coordinate his work with the Work of this Contract as directed, the Owner will promptly investigate the charge. If the Owner finds it to be true, the Owner will promptly issue such directions to the other contractor with respect thereto as the situation may require and issue a response to the Contractor in writing. The Owner, nor any of the Owner's agents, shall not be liable for any damages suffered by the Contractor by reason of the other contractor's failure to promptly comply with the directions so issued by the Owner, or by reason of another contractor's default in performance, it being understood that the Owner does not guarantee the responsibility or continued efficiency of any contractor.

D. The Contractor shall indemnify and hold the Owner harmless from any and all claims of judgments for damages and from costs and expenses to which the Owner may be subjected or which it may suffer or incur by reason of the Contractor's failure to comply with the Owner's directions promptly.

E. Should the Contractor sustain any damage through any act or omission of any other contractor having a contract with the Owner for the performance of work upon the site or of work which may be necessary to be performed for the proper execution of the Work to be performed hereunder, or through any act or omission of a subcontractor of such Contract, the Contractor shall have no claim against the Owner for such damage, but shall have a right to recover such damage from the other contractor through other outside legal pursuits.

F. Should any other contractor having or who shall hereafter have a Contract with the Owner for the performance of work upon the site sustain any damage through any act or omission of the Contractor hereunder or through any act or omission of any subcontractor of the Contractor, the Contractor agrees to reimburse such other contractor for all such damages and to defend at his own expense any suit based upon such claim and if any judgment or claims against the Owner shall be allowed, the Contractor shall pay or satisfy such judgment or claim and pay all costs and expenses in connection therewith and shall indemnify and hold the Owner harmless from all such claims.

G. The Owner's right to indemnification hereunder shall in no way be diminished, waived or discharged, by its recourse to assessment of liquidated damages as provided in the Contract, or by the exercise of any other remedy provided for by Contract Documents or by law.

1.18 LIMITS OF WORK AREA

A. The Contractor shall confine his construction operations within the Contract limits shown on the Drawings and/or property lines and/or fence lines. Storage of equipment and materials, or erection and use of sheds outside of the Contract limits, if such areas are the property of the Owner, shall be used only with the Owner's approval. Such storage or temporary structures, even within the Contract's limits, shall be confined to the Owner's property and shall not be placed on properties designated as easements or rights-of-way unless specifically permitted elsewhere in the Contract Documents.

1.19 WEATHER CONDITIONS

A. No Work shall be done when the weather is unsuitable. The Contractor shall take necessary precautions (in the event of impending severe weather, including hurricanes, tropical storms or major rain/wind storms) to protect all Work, materials, or equipment from damage or deterioration due to floods, driving rain, and/or wind. The Owner reserves the right, to order that additional protection measures over and beyond those proposed by the Contractor, be taken to safeguard all components of the Project.

B. The mixing and placing of concrete or pavement courses, the laying of masonry, and installation of sewers and water mains shall be stopped during rainstorms, and all freshly placed Work shall be protected by canvas or other suitable covering in such manner as to prevent running water from coming in contact with it. Sufficient coverings shall be provided and kept ready at hand for this purpose. The limitations and requirements for mixing and placing concrete, or laying of masonry, in cold weather shall be as described elsewhere in these Specifications.

1.20 PERIODIC CLEANUP: BASIC SITE RESTORATION

A. During construction, the Contractor shall regularly remove from the site of the Work all accumulated debris and surplus materials of any kind which result from his operations. Unused equipment and tools shall be stored at the Contractor's yard or base of operations for the Project.

B. When the Work involves installation of sewers, drains, water mains, manholes, underground structures, or other disturbance of existing features in or across access roads and paths, driveways, public streets, rights-of-way, easements, or private property, the Contractor shall (as the Work progresses) promptly backfill, compact, grade, and otherwise restore the disturbed area to the basic condition which will permit resumption of pedestrian or vehicular traffic and any other critical activity or functions consistent with the original use of the land. The requirements for temporary paving of streets, walks, and driveways are specified elsewhere. Unsightly mounds of earth, large stones, boulders, and debris shall be removed so that the site presents a neat appearance.

C. The Contractor shall perform the cleanup Work on a regular basis and as frequently as ordered by the Owner. Basic site restoration in a particular area shall be accomplished immediately following the installation or completion of the required facilities in that area. Furthermore, such Work shall also be accomplished, when ordered by the Owner, if partially completed facilities must remain incomplete for some time period due to unforeseen circumstances.

D. Upon failure of the Contractor to perform periodic cleanup and basic restoration of the site to the Owner's satisfaction, the Owner may, upon five days prior written notice to the Contractor, without prejudice to any other rights or remedies of the Owner, cause such Work for which the Contractor is responsible to be accomplished to the extent deemed necessary by the Owner, and all costs resulting therefrom shall be charged to the Contractor and deducted from the amounts of money that may be due him.

1.21 USE OF FACILITIES BEFORE COMPLETION

A. The Owner reserves the right to enter and use any portion of the constructed facilities before final completion of the whole Work to be done under this Contract. However, only those portions of the facilities which have been completed to the Owner's satisfaction, as evidenced by his issuing a Certificate of Substantial Completion to the Contractor covering that part of the Work, shall be placed in service.

B. It shall be the Contractor's responsibility to prevent premature connections to or use of any portion of the installed facilities before the Owner issues a Certificate of Substantial Completion covering that portion of the Work to be placed in service.

C. Consistent with the approved progress schedule, the Contractor shall cooperate with the Owner to accelerate completion of those facilities, or portions thereof, which have been designated for early use by the Owner.

D. The Contractor shall ensure that smoking on County property is strictly prohibited by all employees and all employees of subcontractors during the full extent of the project.

1.22 WORK PLANNING FOR CRITICAL FUNCTIONS

A. When the work involves requests for after-hours work, interruption of operations of any kind, demolition of any kind, tie-ins to existing processes and piping, and/or training events, written notice shall be given to the County in the form of a detailed work plan a minimum of 3 calendar days prior to the early start date for the work being considered.

B. In as much as possible, such critical work functions shall be identified and brought up a the progress meeting preceding the need for such work.

C. The County will have final approval on the details, timing, and scheduling of all such work to best avoid any potential for non-compliance of permit conditions and to assure adequate County personnel are available as needed.

1.23 SITE CONDITIONS

A. The Contractor acknowledges that he has investigated prior to bidding and satisfied himself as to the conditions affecting the Work, including but not restricted to those bearing upon transportation, disposal, handling and storage of materials, availability of labor, water, electric power, roads and uncertainties of weather, river stages, tides, water tables or similar physical conditions at the site, the conformation and conditions of the ground, the character of equipment and facilities needed preliminary to and during prosecution of the Work. The Contractor further acknowledges that he has satisfied himself as to the

character, quality and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, or any contiguous site, as well as from information presented by the Drawings and Specifications made a part of this Contract, or any other information made available to him prior to receipt of Bids. Any failure by the Contractor to acquaint himself with the available information will not relieve him from responsibility for estimating properly the difficulty or cost of successfully performing the Work. The County assumes no responsibility for any conclusions or interpretations made by the Contractor on the basis of the information made available by the County.

1.24 DIFFERING SITE CONDITIONS

A. The Contractor shall promptly and before such conditions are disturbed, notify the County in writing of: (1) subsurface or latent physical conditions at the site differing materially from those indicated in this contract, or (2) unknown physical conditions at the site, of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for this contract. The County will promptly investigate the conditions, and if he finds that such conditions do materially so differ and cause an increase or decrease in the Contractor's cost of, or the time required for, performance of any part of the work under this contract, whether or not changed as a result of such conditions, an equitable adjustment shall be made and the contract modified in writing accordingly.

B. No claim of the Contractor under this clause shall be allowed unless the Contractor has given the notice required in Paragraph A.

C. No claim by the Contractor for an equitable adjustment hereunder shall be allowed if asserted after final payment under this contract.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION –

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GFA INTERNATIONAL

FLORIDA'S LEADING ENGINEERING SOURCE

Report of Geotechnical Exploration

Lee County Fiesta Village WWTP Sludge Dewatering System and Hypochlorite Storage Tank Improvements
1366 San Souci Drive
Fort Myers, Lee County, Florida

February 9, 2018
GFA International Project No.: 17-4537

For: Hazen and Sawyer

February 9, 2018

Mr. Jacob L. Porter, P.E., BCEE
Hazen and Sawyer
10002 Princess Palm Avenue, Suite 200
Tampa, FL 33619
Phone: (813) 549-2130
Email: JPorter@HazenandSawyer.com

Project: **Lee County Fiesta Village WWTP Sludge Dewatering System And Hypochlorite Storage Tank Improvements**
1366 San Souci Drive
Fort Myers, Lee County, Florida
GFA International Project No. 17-4537.00

Dear Mr. Porter:

GFA International, Inc. (GFA) has completed the subsurface exploration and geotechnical engineering evaluation for the above-referenced project in accordance with the geotechnical and engineering service agreement for this project. The scope of services was completed in accordance with our Geotechnical Engineering Proposal (17-4537.00), planned in conjunction with and authorized by you.

EXECUTIVE SUMMARY

The purpose of our subsurface exploration was to classify the nature of the subsurface soils and general geomorphic conditions. This report contains the results of our subsurface exploration at the site and our engineering interpretations of these.

GFA understands the project will consist of the new construction of a permanent centrifuge dewatering system as well as the relocation of the existing hypochlorite storage tanks. Document provided was a "FV Exhibit A: Scope of Services" (10 pages, dated 5/16/2017). No other documents were provided at this time. GFA understand both foundations will be slabs on grade with a minimum soil bearing capacity of 2000 psf.

The following testing was completed of this study:

- Two (2) Standard Penetration Test (SPT) borings advanced to depths up to twenty-five (25) feet below existing site grade within the footprint of the proposed centrifuge.

- Two (2) Standard Penetration Test (SPT) borings advanced to depths up to twenty-five (25) feet below existing site grade within the footprint of the proposed hypochlorite storage tanks.

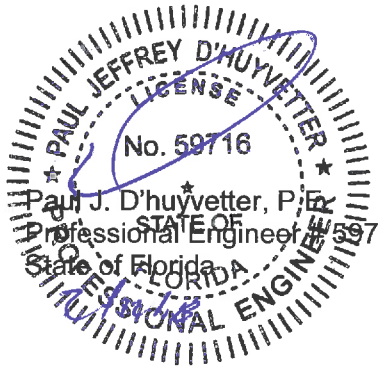
The subsurface soil conditions encountered at this site generally consists of very loose to dense sand (SP), very loose to medium dense sand with silt (SP-SM),very loose to medium dense silty sand (SM), and soft weathered limestone (WLS) to the boring termination depths. Please refer to "Appendix D: Record of Test Borings" for a detailed account of each boring.

The subsurface soil conditions at the project site are generally favorable for the support of both structures on shallow foundations. An allowable bearing capacity of 2,000 psf may be used for foundation design. Expected settlement of the structure is less than 1 in total and less that ½ inch differential.

We appreciate the opportunity to be of service to you on this project and look forward to a continued association. Please do not hesitate to contact us if you have any questions or comments, or if we may further assist you as your plans proceed.

Respectfully Submitted,
GFA International, Inc.
Florida Certificate of Authorization Number 4930

Jose D. Castano, E.I.
Staff Engineer



Paul J. D'huyvetter, P.E.
Professional Engineer # 59716
State of Florida

Copies: 1, Addressee

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 Scope of Services

The objective of our geotechnical services was to collect subsurface data for the subject project, summarize the test results, and discuss any apparent site conditions that may have geotechnical significance for building construction. The following scope of service is provided within this report:

1. Prepare records of the soil boring logs depicting the subsurface soil conditions encountered during our field exploration.

2. Conduct a review of each soil sample obtained during our field exploration for classification and additional testing if necessary.

3. Analyze the existing soil conditions found during our exploration with respect to foundation support for the proposed structure.

4. Provide recommendations with respect to foundation support of the structure, including allowable soil-bearing capacity, bearing elevations, and foundation design parameters.

1.2 Project Description

GFA understands the project will consist of the new construction of a permanent centrifuge dewatering system as well as the relocation of the existing hypochlorite storage tanks. Document provided was a “FV Exhibit A: Scope of Services” (10 pages, dated 5/16/2017). No other documents were provided at this time. GFA understand both foundations will be slabs on grade with a minimum soil bearing capacity of 2000 psf.

2.0 OBSERVATIONS

2.1 Site Inspection

The recovered samples were not examined, either visually or analytically, for chemical composition or environmental hazards. GFA would be pleased to perform these services for an additional fee, if required.

2.2 Field Exploration

The following testing was completed of this study:

- Two (2) Standard Penetration Test (SPT) borings advanced to depths up to twenty-five (25) feet below existing site grade within the footprint of the proposed centrifuge.

- Two (2) Standard Penetration Test (SPT) borings advanced to depths up to twenty-five (25) feet below existing site grade within the footprint of the proposed hypochlorite storage tanks.

The locations of the borings performed are illustrated in “Appendix B: Test Location Plan". The Standard Penetration Test (SPT) boring method was used as the investigative tool within the borings. SPT tests were performed in substantial accordance with ASTM Procedure D-1586, “Penetration Test and Split-Barrel Sampling of Soils”. This test procedure consists of driving a 1.4-inch I.D. split-tube sampler into the soil profile using a 140-pound hammer falling 30 inches. The number of blows per foot, for the second and third 6-inch increment, is an indication of soil strength.

The soil samples recovered from the soil borings were visually classified and their stratification is illustrated in “Appendix D: Record of Test Borings". It should be noted that soil conditions might vary between the strata interfaces, which are shown. The soil boring data reflect information from a specific test location only. Site specific survey staking for the test locations was not provided for our field exploration. The indicated depth and location of each test was approximated based upon existing grade and estimated distances and relationships to obvious landmarks. The boring depths were selected based on our knowledge of vicinity soils and to include the zone of soil likely to be stressed by the proposed construction.

2.3 Laboratory Analysis

Soil samples recovered from our field exploration were returned to our laboratory where they were visually examined in general accordance with ASTM D-2488. Samples were evaluated to obtain an accurate understanding of the soil properties and site geomorphic conditions. After a thorough visual examination of the recovered site soils, no laboratory testing was deemed necessary. Bag samples of the soil encountered during our field exploration will be held in our laboratory for your inspection for 30 days and then discarded unless we are notified otherwise in writing.

2.4 Geomorphic Conditions

Boring logs derived from our field exploration are presented in “Appendix D: Record of Test Borings”. The boring logs depict the observed soils in graphic detail. The Standard Penetration Test borings indicate the penetration resistance, or N-values, logged during the drilling and sampling activities. The classifications and descriptions shown on the logs are generally based upon visual characterizations of the recovered soil samples. All soil samples reviewed have been depicted and classified in general accordance with the Unified Soil Classification System, modified as necessary to describe typical southwest Florida conditions. See “Appendix E: Discussion of Soil Groups", for a detailed description of various soil groups.

The subsurface soil conditions encountered at this site generally consists of very loose to dense sand (SP), very loose to medium dense sand with silt (SP-SM),very loose to medium dense silty sand (SM), and soft weathered limestone (WLS) to the boring termination depths. Please refer to “Appendix D: Record of Test Borings” for a detailed account of each boring.

2.5 Hydrogeological Conditions

On the dates of our field exploration, the groundwater table was encountered at depths approximately 6 feet below the existing ground surface. The groundwater table will fluctuate seasonally depending upon local rainfall and other site specific and/or local influences such as tidal events. Brief ponding of stormwater may occur across the site after heavy rains.

No additional investigation was included in our scope of work in relation to the wet seasonal high groundwater table or any existing well fields in the vicinity. Well fields may influence water table levels and cause significant fluctuations. If a more comprehensive water table analysis is necessary, please contact our office for additional guidance.

3.0 ENGINEERING EVALUATION AND RECOMMENDATIONS

3.1 General

A foundation system for any structure must be designed to resist bearing capacity failures, have settlements that are tolerable, and resist the environmental forces that the foundation may be subjected to over the life of the structure. The soil bearing capacity is the soil's ability to support loads without plunging into the soil profile. Bearing capacity failures are analogous to shear failures in structural design and are usually sudden and catastrophic.

The amount of settlement that a structure may tolerate is dependent on several factors including: uniformity of settlement, time rate of settlement, structural dimensions and properties of the materials. Generally, total or uniform settlement does not damage a structure but may affect drainage and utility connections. These can generally tolerate movements of several inches for building construction. In contrast, differential settlement affects a structure's frame and is limited by the structural flexibility.

The subsurface soil conditions at the project site are generally favorable for the support of the proposed structures on shallow foundations.

3.2 Site Preparation

GFA recommends the following compaction requirements for this project:

- Proof Roll ..... 95% of a Modified Proctor
- Building Pad Fill..... 95% of a Modified Proctor
- Footings ..... 95% of a Modified Proctor

The compaction percentages presented above are based upon the maximum dry density as determined by a "modified proctor" test (ASTM D-1557). All density tests should be performed to a depth of 12" below the tested surface unless noted otherwise. All density tests should be performed using the nuclear method (ASTM D-6938) or the sand cone method (ASTM D-1556).

Our recommendations for preparation of the site for use of shallow foundation systems are presented below. This approach to improving and maintaining the site soils has been found to be successful on projects with similar soil conditions.

1. Initial site preparation should consist of performing stripping and clearing operations. This should be done within, and to a distance of five (5) feet beyond, the perimeter of the proposed building footprint (including exterior isolated columns).

2. Following site stripping and prior the placement of any fill, areas of surficial sand (not exposed limestone) should be compacted ("proof rolled") and tested. We recommend using a steel drum vibratory roller with sufficient static weight and vibratory impact energy to achieve the required compaction. Density tests should be performed on the proof rolled surface at a frequency of not less than one test per 2,500 square feet, or a minimum of four (4) tests, whichever is greater. Areas of exposed intact limestone shall be visually confirmed by the project geotechnical engineer prior to fill placement, in lieu of proof rolling.

3. Fill material may then be placed in the building pad as required. The fill material should be inorganic (classified as SP, SW, GP, GW, SP-SM, SW-SM, GW-GM, GP-GM) containing not more than 5 percent (by weight) organic materials. **Fill materials with silt-size soil fines in excess of 12% should not be used.** Fill should be placed in lifts with a maximum lift thickness not exceeding 12-inches. Each lift should be compacted and tested prior to the placement of the next lift. Density tests should be performed within the fill at a frequency of not less than one test per 2,500 square feet per lift in the building areas, or a minimum of four (4) tests per lift, whichever is greater.

4. For any footings bearing on a limestone formation, the bottom of all footing excavation shall be examined by the engineer / geologist or his representative to determine the condition of the limestone. The limestone shall be probed for voids and loose pockets of sand. Such areas shall be cleaned to depth of 3 times the greatest horizontal dimension and backfilled with lean concrete.

5. For footings placed on structural fill or compacted native granular soils, the bottom of all footings shall be tested for compaction and examined by the engineer / geologist or his representative to determine if the soil is free of organic and/or deleterious material. Density tests should be performed at a frequency of not less than one (1) density test per each isolated column footing and one (1) test per each fifty (50) lineal feet of wall footings.

6. The contractor should take into account the final contours and grades as established by the plan when executing his backfilling and compaction operations.

Using vibratory compaction equipment at this site may disturb adjacent structures. We recommend that you monitor nearby structures before and during proof-compaction operations. A representative of GFA International can monitor the vibration disturbance of adjacent structures. A proposal for vibration monitoring during compaction operations can be supplied upon request.

3.3 Design of Footings

Footings may be designed using an allowable soil bearing pressure of 2,000 psf. Shallow foundations should be embedded a minimum of 18 inches below final grade. This embedment shall be measured from the lowest adjacent grade. Isolated column footings should be at least 24 inches in width and continuous strip footings should have a width of at least 18 inches regardless of contact pressure.

Once site preparation has been performed in accordance with the recommendations described in this report, the soil should readily support the proposed structure resting on a shallow foundation system. Settlements have been projected to be less than 1-inch total and ½-inch differential. All footings and columns should be structurally separated from the floor slab, as they will be loaded differently and at different times, unless a monolithic mat foundation is designed.

3.4 Ground Floor Slabs

The ground floor slabs may be supported directly on the existing grade or on granular fill following the foundation site preparation and fill placement procedures outlined in this report. For purposes of design, a coefficient of subgrade modulus 150 pounds per cubic inch may be used. The ground floor slab should be structurally separated from all walls and columns to allow for differential vertical movement.

Excessive moisture vapor transmission through floor slabs-on-grade can result in damage to floor coverings as well as other deleterious affects. An appropriate moisture vapor retarder should be placed beneath the floor slab to reduce moisture vapor from entering the building through the slab. The retarder should be installed in general accordance with applicable ASTM procedures including sealing around pipe penetrations and at the edges of foundations.

4.0 REPORT LIMITATIONS

This consulting report has been prepared for the exclusive use of the current project owners and other members of the design team for the Lee County Fiesta Village Wastewater Treatment Plan Sludge Dewatering System and Hypochlorite Storage Tank Improvements project located in Fort Myers, Lee County, Florida. This report has been prepared in accordance with generally accepted local geotechnical engineering practices; no other warranty is expressed or implied. The evaluation submitted in this report, is based in part upon the data collected during a field exploration, however, the nature and extent of variations throughout the subsurface profile may not become evident until the time of construction. If variations then appear evident, it may be necessary to reevaluate information and professional opinions as provided in this report. In the event changes are made in the nature, design, or locations of the proposed structure, the evaluation and opinions contained in this report shall not be considered valid, unless the changes are reviewed and conclusions modified or verified in writing by GFA International. GFA is not responsible for damage caused by soil improvement and/or construction activity vibrations related to this project. GFA is also not responsible for damage concerning drainage or moisture related issues for the proposed or nearby structures.

GFA should be provided the opportunity to review the final foundation specifications and review foundation design drawings, in order to determine whether GFA's recommendations have been properly interpreted, communicated and implemented. If GFA is not afforded the opportunity to participate in construction related aspects of foundation installation as recommended in this report or any report addendum, GFA will accept no responsibility for the interpretation of our recommendations made in this report or on a report addendum for foundation performance.

5.0 BASIS FOR RECOMMENDATIONS

The analysis and recommendations submitted in this report are based on the data obtained from the tests performed at the locations indicated on the attached figure in Appendix B. This report does not reflect any variations, which may occur between borings. While the borings are representative of the subsurface conditions at their respective locations and for their vertical reaches, local variations characteristic of the subsurface soils of the region are anticipated and may be encountered. The delineation between soil types shown on the soil logs is approximate and the description represents our interpretation of the subsurface conditions at the designated boring locations on the particular date drilled.

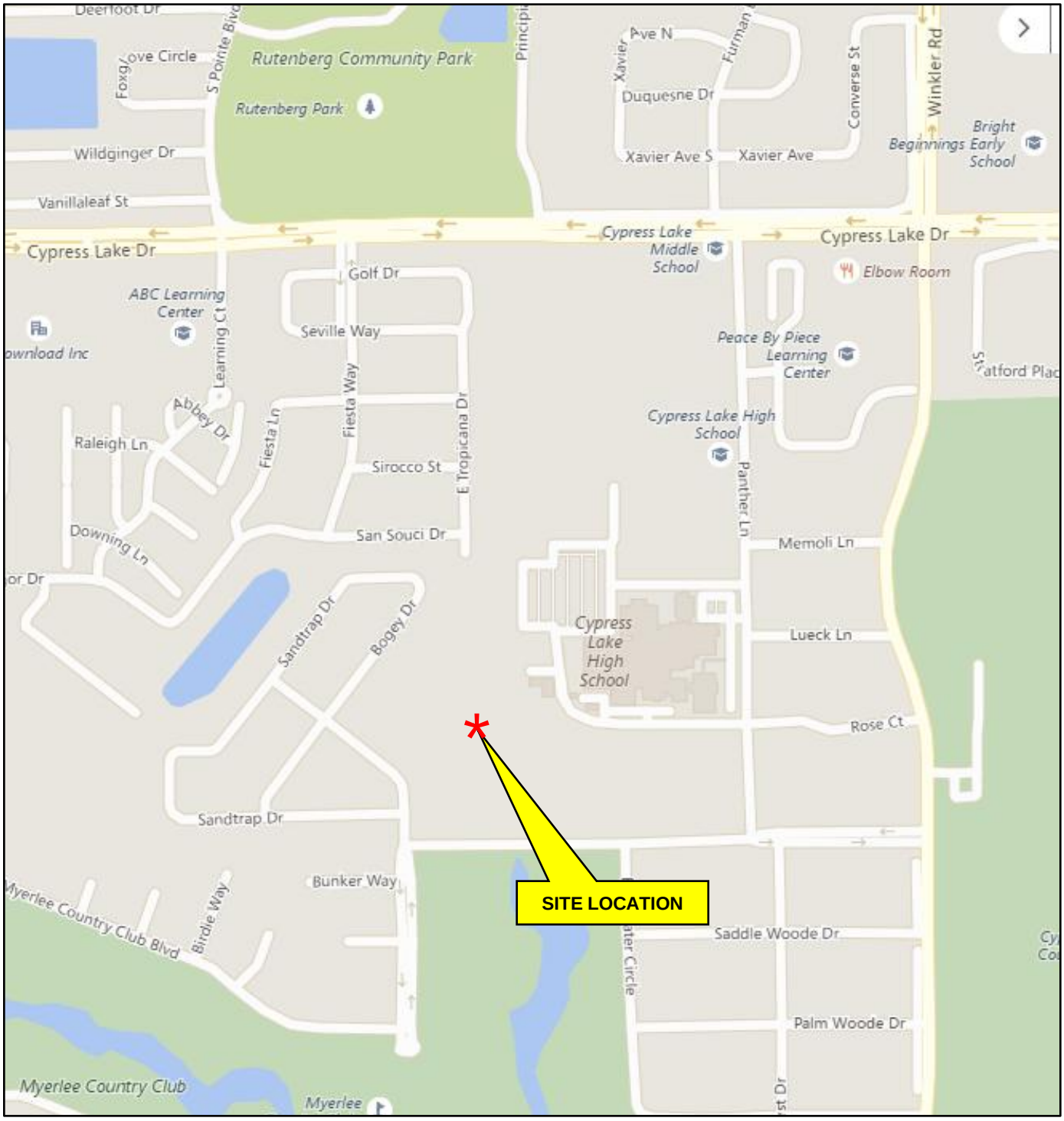
Any third party reliance of our geotechnical report or parts thereof is strictly prohibited without the expressed written consent of GFA International. The methodology (ASTM D-1586) used in performing our borings and for determining penetration resistance is specific to the sampling tools utilized and does not reflect the ease or difficulty to advance other tools or materials.

Appendix A - Vicinity Map

VICINITY MAP

Lee County Fiesta Village Wastewater Treatment Plant

1366 San Souci Drive
Fort Myers, Lee County, Florida
GFA International Project No.: 17-4537



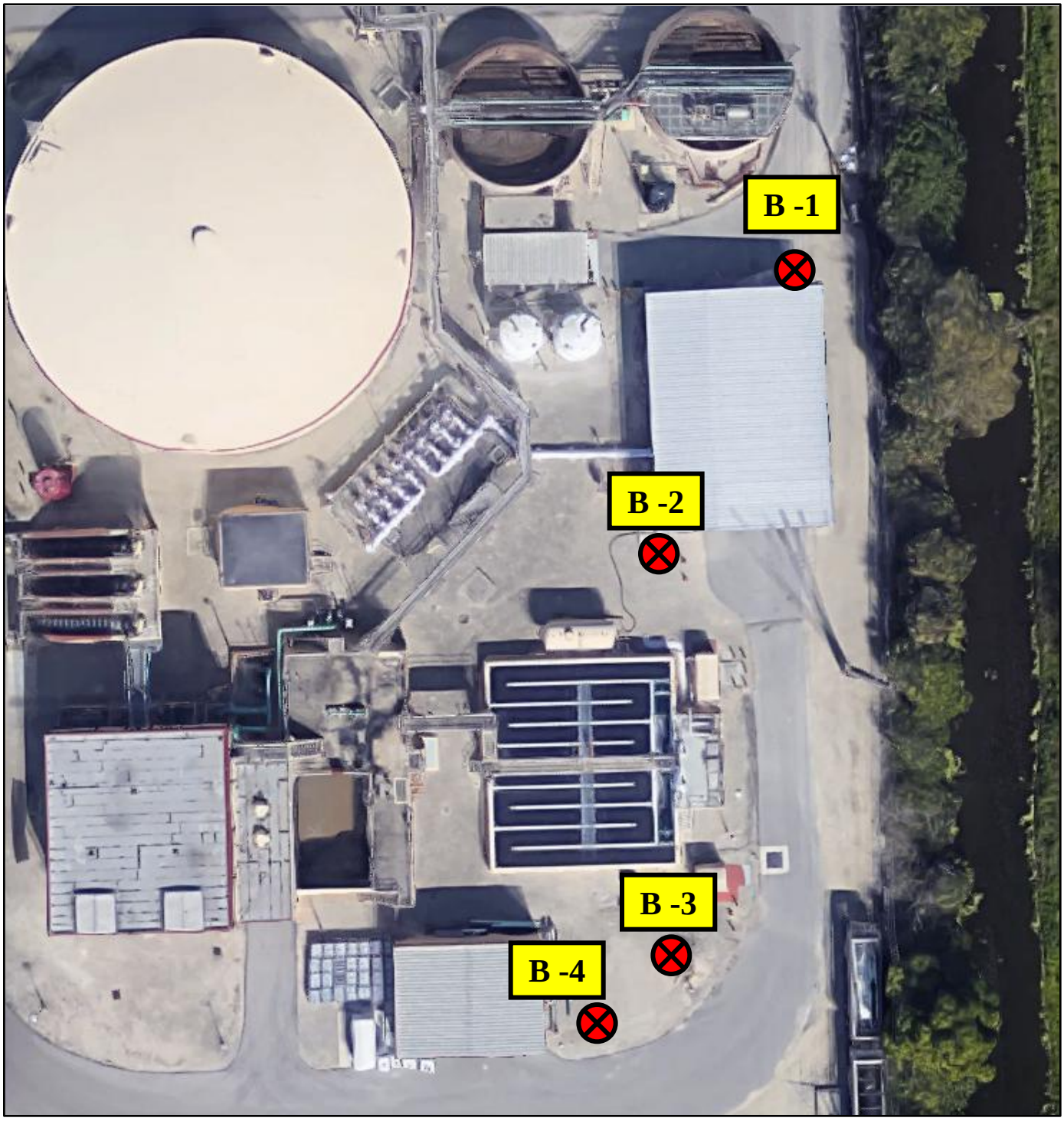
Appendix B – Boring Location Plan

TEST LOCATION PLAN

Lee County Fiesta Village Wastewater Treatment Plant

1366 San Souci Drive
Fort Myers, Lee County, Florida
GFA International Project No.: 17-4537

N
W
E
S
ENVIRONMENTAL • GEOTECHNICAL • MATERIALS TESTING • INSPECTIONS
GFA



⊗ SPT Soil Boring

Appendix C - Notes Related to Borings

NOTES RELATED TO
RECORDS OF TEST BORING AND
GENERALIZED SUBSURFACE PROFILE

1. Groundwater level was encountered and recorded (if shown) following the completion of the soil test boring on the date indicated. Fluctuations in groundwater levels are common; consult report text for a discussion.

2. The boring location was identified and located in the field based on measured and estimated distances from existing site features.

3. The borehole was backfilled to site grade following boring completion, patched with asphalt cold patch mix when pavement was encountered.

4. The Record of Test Boring represents our interpretation of field conditions based on engineering examination of the soil samples.

5. The Record of Test Boring is subject to the limitations, conclusions, and recommendations presented in the report text.

6. The Standard Penetration Test (SPT) was performed in accordance ASTM Procedure D-1586. SPT testing procedure consists of driving a 1.4-inch I.D. split-tube sampler into the soil profile using a 140-pound hammer falling 30 inches.

7. On the Record of Test Boring listed as "Blow Counts", the N-value is the sum of the SPT hammer blows required to drive the split-tube sampler through the second and third 6-inch increment of the sampling layer, and is an indication of soil strength.

8. Shown on the Record of Test Boring an SPT N-value expressed as 50/2" is descriptive of the fact that 50 hammer blows were required to drive the split-spoon sampler a distance of approximately 2 inches.

9. The soil/rock strata interfaces shown on the Records of Test Boring are approximate and may vary from those in the field. The soil/rock conditions shown on the Records of Test Boring refer to conditions at the specific location tested; soil/rock conditions may vary between test locations.

10. Relative density and consistency for sands/gravels, silts/clays, and limestone are described as follows:

Cohesionless Soils	
SPT (N-Value)	Relative Density
0 – 3	Very Loose
4 – 8	Loose
9 – 24	Medium Dense
25 – 40	Dense
Over 40	Very Dense

Silts and Clays	
SPT (N-Value)	Consistency
0 – 1	Very Soft
2 – 4	Soft
4 – 6	Firm
7 – 12	Stiff
13 – 24	Very Stiff
Over 24	Hard

Limestone	
SPT (N-Value)	Relative Density
0 – 19	Very Soft
20 – 49	Soft
50 – 100	Medium Hard
50 for 3 to 5"	Moderately Hard
50 for 0 to 2"	Hard

11. Definition of descriptive terms of modifiers for silts/clays/shells/gravels are described as follows:

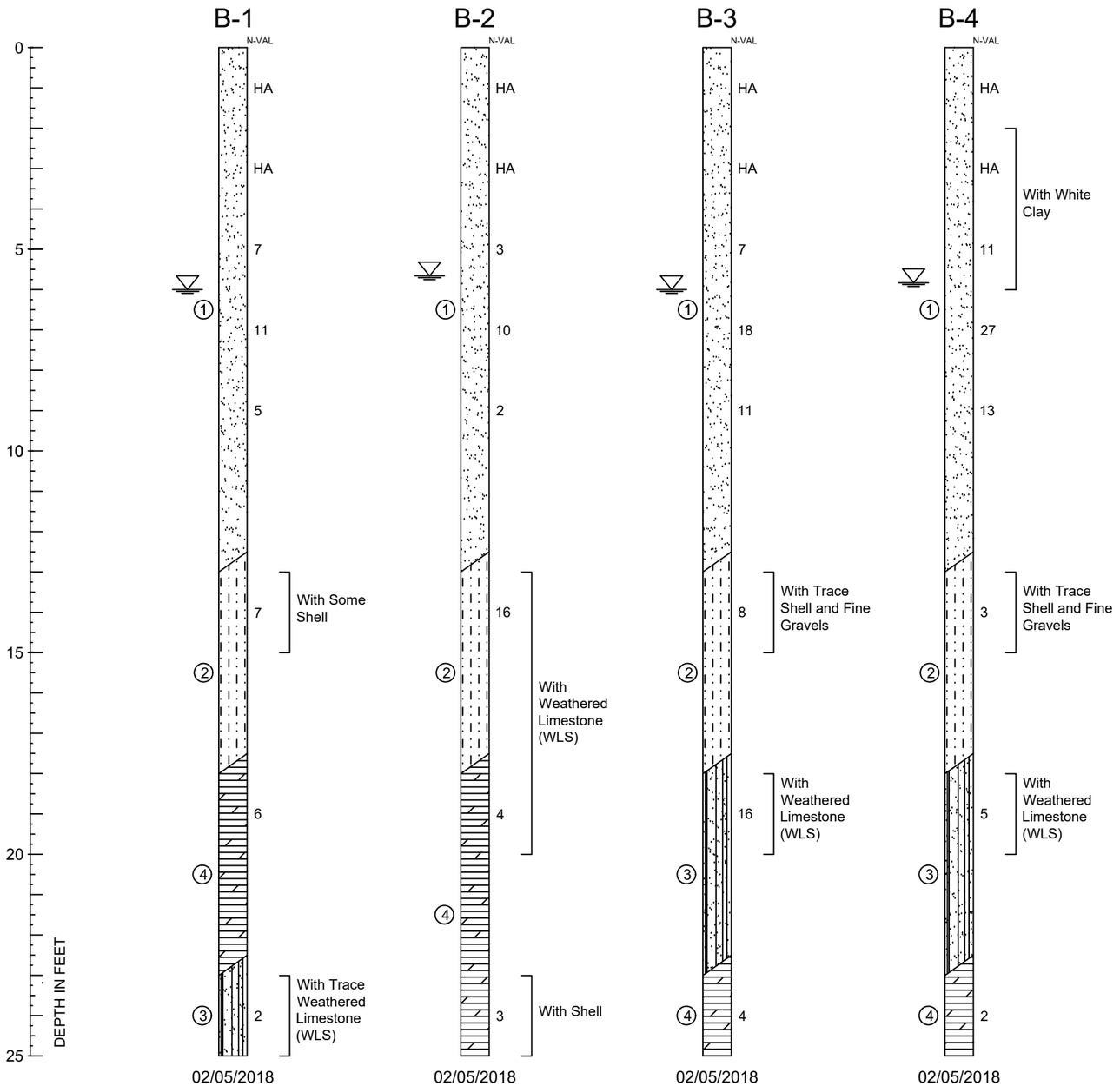
Percentage of Modifier Material	First Qualifier	Second Qualifier
0 – 5	With a Trace of + Modifier	With a Trace
5 – 12	Slightly + Modifier + y	With Some
12 – 30	Modifier + y	With
30 – 50	Very + Modifier + y	And

12. Descriptive characteristics for organic content percentages are described as follows:

Percentage of Organic Material	Descriptor
0 – 5	With a Trace
5 – 20	With Organics
20 – 75	Highly Organic
75 – 100	Peat

Appendix D - Record of Test Borings

SOIL PROFILES



SOIL PROFILE LEGEND

B-X = BORING NUMBER

SOIL TYPE (X) — SOIL SYMBOL — N = SPT TEST VALUE

GROUND WATER LEVEL

INDICATES PRACTICAL REFUSAL TO BORING EQUIPMENT

= INDICATES GRADUAL TRANSITION IN SOIL TYPES

SOIL LEGEND

1. Gray, Light Brown to Brown, SAND (SP) Very Loose to Dense
2. Gray, SAND WITH SILT (SP-SM) Very Loose to Medium Dense
3. Gray, SILTY SAND (SM) Very Loose to Medium Dense
4. Gray, WEATHERED LIMESTONE (WLS) Very Soft

NOTES:

N - STANDARD PENETRATION RESISTANCE TEST (SPT) VALUE. NUMBERS TO THE RIGHT OF BORINGS INDICATE SPT VALUE FOR 12-INCHES OF PENETRATION (UNLESS OTHERWISE NOTED).

WOH - BORING INTERVAL ADVANCED UNDER WEIGHT OF HAMMER.

WOR - BORING INTERVAL ADVANCED UNDER WEIGHT OF ROD.

LFC - LOSS OF DRILLING FLUID CIRCULATION.

WLS - WEATHERED LIMESTONE

HA - NO RECORDED N-VALUE DUE TO HAND AUGERING PROCEDURE

SOIL CLASSIFICATION

CORRELATION OF N - VALUES WITH RELATIVE DENSITY AND CONSISTENCY

COHESIONLESS SOIL

N - VALUE	RELATIVE DENSITY
0 - 3	VERY LOOSE
4 - 8	LOOSE
9 - 24	MEDIUM DENSE
25 - 40	DENSE
OVER 40	VERY DENSE

SILTS AND CLAYS

N - VALUE	CONSISTENCY
0 - 1	VERY SOFT
2 - 4	SOFT
5 - 6	FIRM
7 - 12	STIFF
13 - 24	VERY STIFF
OVER 24	HARD

CORRELATION OF N - VALUES WITH HARDNESS DESCRIPTION

LIMEROCK

N - VALUE	RELATIVE DENSITY
0 - 19	VERY SOFT
20 - 49	SOFT
50 - 100	MEDIUM HARD
50 FOR 3 TO 5"	MODERATELY HARD
50 FOR 0 TO 2"	HARD

APPROXIMATE FINES CONTENT	MODIFIERS
5% TO 15%	SLIGHTLY SILTY OR SLIGHTLY CLAYEY
16% TO 25%	SILTY OR CLAYEY
26% TO 49%	VERY SILTY OR VERY CLAYEY

APPROXIMATE SHELL CONTENT	MODIFIERS
0% TO 5%	WITH A TRACE OF SHELL
6% TO 12%	SLIGHTLY SHELLY
13% TO 30%	SHELLY
31% TO 50%	VERY SHELLY

APPROXIMATE ORGANIC CONTENT	MODIFIERS
0% TO 5%	WITH A TRACE
5% TO 20%	WITH ORGANICS
20% TO 75%	HIGHLY ORGANIC
75% TO 100%	PEAT

DEFINITION OF DESCRIPTIVE TERMS OF MODIFIERS FOR SILTS/CLAYS/SHELLS/GRAVELS ARE DESCRIBED AS FOLLOWS:

PERCENTAGE OF MODIFIER MATERIAL	FIRST QUALIFIER	SECOND QUALIFIER
0 - 5	WITH A TRACE OF + MODIFIER	WITH A TRACE
5 - 12	SLIGHTLY + MODIFIER + Y	WITH SOME
12 - 30	MODIFIER + Y	WITH
30 - 50	VERY + MODIFIER + Y	AND

RECORD OF TEST BORINGS

GFA International, Inc.
5851 Country Lakes Drive
Fort Myers, Florida 33905
239-489-2443 * TeamGFA.com

Client: Hazen & Sawyer

Project:
Fiesta WWTP Dewatering
1366 San Souci Drive
Fort Myers, Lee County, Florida

Date: 02/06/2018
Job No: 17-4537
Drawn By: JDC
Approved by: PJD

Appendix E - Discussion of Soil Groups

DISCUSSION OF SOIL GROUPS

COARSE GRAINED SOILS

GW and SW GROUPS. These groups comprise well-graded gravelly and sandy soils having little or no plastic fines (less than 5 percent passing the No. 200 sieve). The presence of the fines must not noticeably change the strength characteristics of the coarse-grained fraction and must not interface with it's free-draining characteristics.

GP and SP GROUPS. Poorly graded gravels and sands containing little of no plastic fines (less than 5 percent passing the No. 200 sieve) are classed in GP and SP groups. The materials may be called uniform gravels, uniform sands or non-uniform mixtures of very coarse material and very fine sands, with intermediate sizes lacking (sometimes called skip-graded, gap-graded or step-graded). This last group often results from borrow pit excavation in which gravel and sand layers are mixed.

GM and SM GROUPS. In general, the GM and SM groups comprise gravels or sands with fines (more than 12 percent passing the No. 200 sieve) having low or no plasticity. The plasticity index and liquid limit of soils in the group should plot below the "A" line on the plasticity chart. The gradation of the material is not considered significant and both well and poorly graded materials are included.

GC and SC GROUPS. In general, the GC and SC groups comprise gravelly or sandy soils with fines (more than 12 percent passing the No. 200 sieve), which have a fairly high plasticity. The liquid limit and plasticity index should plot above the "A" line on the plasticity chart.

FINE GRAINED SOILS

ML and MH GROUPS. In these groups, the symbol M has been used to designate predominantly silty material. The symbols L and H represent low and high liquid limits, respectively, and an arbitrary dividing line between the two is set at a liquid limit of 50. The soils in the ML and MH groups are sandy silts, clayey silts or inorganic silts with relatively low plasticity. Also included are loess type soils and rock flours.

CL and CH GROUPS. In these groups the symbol C stands for clay, with L and H denoting low or high liquid limits, with the dividing line again set at a liquid limit of 50. The soils are primarily inorganic clays. Low plasticity clays are classified as CL and are usually lean clays, sandy clays or silty clays. The medium and high plasticity clays are classified as CH. These include the fat clays, gumbo clays and some volcanic clays.

OL and OH GROUPS. The soil in the OL and OH groups are characterized by the presence of organic odor or color, hence the symbol O. Organic silts and clays are classified in these groups. The materials have a plasticity range that corresponds with the ML and MH groups.

HIGHLY ORGANIC SOILS

The highly organic soils are usually very soft and compressible and have undesirable construction characteristics. Particles of leaves, grasses, branches, or other fibrous vegetable matter are common components of these soils. They are not subdivided and are classified into one group with the symbol PT. Peat humus and swamp soils with a highly organic texture are typical soils of the group.

SECTION 01026

MEASUREMENT AND PAYMENT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Payment for the various items in the Schedule of Payment items, as further specified herein, shall include all compensation to be received by the Contractor for furnishing all tools, equipment, supplies, and manufactured articles, and for all labor, operations, taxes, materials, commissions, transportation and handling, bonds, permit fees, insurance, overhead and profit, and incidentals appurtenant to the items of Work being described, as necessary to complete the various items of the Work all in accordance with the requirements of the Contract Documents, including all appurtenances thereto, and including all costs of compliance with the regulations of public agencies having jurisdiction, including Safety and Health Requirements of the Occupational Safety and Health Administration of the U.S. Department of Labor (OSHA). Such compensation shall also include payment for any loss or damages arising directly or indirectly from the Work.

B. The Contractor's attention is called to the fact that the quotations for the various items of Work are intended to establish a total price for completing the Work in its entirety. Should the Contractor feel that the cost for any item of Work has not been established by the Schedule of Payment items or this Section, it shall include the cost for that Work in some other applicable bid item, so that its proposal for the project does reflect its total price for completing the Work in its entirety.

1.02 EXPLANATION AND DEFINITIONS

A. The following explanation of the Measurement and Payment for the Bid Schedule items is made for information and guidance. The omission of reference to any item in this description shall not, however, alter the intent of the Bid Schedule or relieve the Contractor of the necessity of furnishing such as a part of the Contract. Measurement and payment for all Contract Items shall be made in accordance with this section or as modified by Supplemental Terms and Conditions.

1.03 MEASUREMENT

A. The indicated in the Bid Schedule are given to establish a uniform basis for the comparison of bids. The amounts listed for each item at time of bid may be adjusted to some extent in developing the Schedule of Values but the overall total of all items in both the Bid Schedule and the Schedule of Values shall equal the total bid amount.

1.04 PAYMENT

A. Make payment for the items listed on the Bid Schedule on the basis of the work actually performed and completed, such work including but not limited to, the furnishing of all

necessary labor, materials, equipment, transportation, clean up, restoration of all disturbed areas, and all other appurtenances to complete the construction and installation of the work as shown on the drawings and described in the specifications.

B. Estimated and mutually agreed upon percent complete values shall be used as a means of computing the amount for periodic payments for work performed. Determining value of additions or deletions during construction may rely upon applicable values as broken down by individual items listed in the approved Schedule of Values.

1.05 SCHEDULE OF VALUES

A. Approval of schedule: Submit for approval a preliminary Schedule of Values for all of the work. Submit preliminary schedule of values within 10 calendar days after the Effective Date of the Agreement (notice to proceed).

B. Format: Utilize the submitted Bid Schedule for the list of individual pay items finalizing actual amounts to be used for payment if different than that initially submitted with the bid. Identify each line item with number and title of the major specification items. Identify site mobilization, bonds and insurance. Include with each line item, a direct proportional amount of Contractor's overhead and profit. Within the Schedule of Values, break down the individual bid schedule items into more specific items included in that bid schedule item (concrete, individual equipment, electrical components, instrumentation, piping sections, startup, training, O&M Manuals, etc). Intent is to break down the work by areas that can more easily allow estimation of the percent complete for each item. Attempt to break down the individual items listed in values of $50,000 or less wherever possible.

C. Revisions: With each Application for Payment, revise schedule to list approved Change Orders.

1.06 EQUIPMENT AND MATERIALS IN STORAGE

A. If the Contractor anticipates the need for payment for materials stored on the project site or off-site in bonded warehouse, it shall also submit a separate list covering the cost of materials, delivered and unloaded with taxes paid. This list shall also include the installed value of the item with coded reference to the Work items in the Schedule of Payment Values. Similar procedures shall be employed for undelivered specifically manufactured equipment and materials as specified herein. Payment for stored materials shall be based on 90 percent of the value of the material (as verified through copies of invoices from the Contractor).

B. Contractor shall plan the installation of the work such that materials are in on-site storage no more than 60 days. If materials stored on site are included in any particular pay application, those materials shall be installed within the next two months from date delivered to the site.

1.07 RELEASE OF LIEN

A. For any item included in a pay application that is to a third party, either a subcontractor or material supplier, a release of lien for those amounts shall be submitted with the next pay application before further payment can be considered.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 SCHEDULE OF PRICES BID – OVERALL PROJECT

A. Item No. 1 – Mobilization / Demobilization: Included in this item are all general conditions and requirements, including but not limited to mobilization activities, scheduling, temporary facilities, obtaining permits, indemnification, general conditions, demobilization, close out, and all other activities necessary to complete the contract work general requirements (pay applications, meetings, submittals, audio-video recordings, photographs, temporary facilities and site protections, field offices, temporary sludge dewatering system, and final close out items). The payment for this bid item shall not exceed 25 percent of the Total Bid Price. Payment shall be made at the contract unit price of a lump sum for this bid item in accordance with the schedule listed below. This price shall be full compensation for furnishing all materials, for all labor, equipment, tools, and incidentals necessary to complete this item. Partial payment shall be made in accordance with the following:

Percent of Original Contract Amount Earned	Allowable Percent of Lump Sum Price for this Item
5	25
25	50
50	75
75	90
100	100

B. Item No. 2 – Civil Site Work: Payment for furnishing and installing all stormwater and site improvements will be made at the contract lump sum price. This item includes all labor, materials, equipment, supplies, and appurtenances necessary for site restoration, roadway improvements and paving, and all other civil/site improvements as required for this project, including but not limited to, survey and staking, earthwork, erosion control, stormwater piping and precast structures, dewatering systems, roadway paving and repair, and final site cleanup and restoration of all areas disturbed by construction activities. Payment shall be made based on a mutually agreed percent complete of the lump sum price for this work item.

C. Item No. 3 – Demolition: Payment for demolition will be made at the contract lump sum price. This item includes, but is not limited to, the demolition and removal or relocation of the existing dewatering building, existing sodium hypochlorite storage tanks, piping, concrete, asphalt, and equipment. Payment shall be made based on a mutually agreed percent complete of the lump sum price for this work item.

D. Item No. 4 – Dewatering Structure Concrete: Payment for furnishing and installing all concrete for the new dewatering structure foundation, lower level slabs, columns, and upper level slabs will be made at the contract lump sum price. This item includes all labor, materials, equipment, services and incidentals necessary for all concrete work at the structure including, but is not limited to, excavation work, formwork, reinforcing steel, concrete and concrete accessories, concrete curing and finishing, embedded trench work and covers, embedded floor drains, handrail, grating, hole covers, curbs, concrete supports, vapor barriers, concrete joint materials, and painting of the concrete surfaces. Payment shall be made based on a mutually agreed percent complete of the lump sum price for this work item.

E. Item No. 5 – Pre-Cast Concrete Electrical Building: Payment for furnishing and installing the pre-cast concrete electrical building will be made at the contract lump sum price. This item includes all labor, materials and equipment necessary for furnishing and installing the pre-cast concrete electrical building and accessories as specified under Section 13400 along with all work associated with the preparation for setting in place, handling, and installation of the building, along with any factory and field painting and waterproofing work for the building, and installation of the building air conditioning system as specified under Section 13400. Payment shall be made based on a mutually agreed percent complete of the lump sum price for this work item.

F. Item No. 6 – Pre-Engineered Steel Dewatering Canopy: Payment for furnishing and installing the pre-engineered steel dewatering structure and accessories as specified under Section 13121 will be made at the contract lump sum price. This item includes all labor, materials and equipment necessary for furnishing and installing the pre-cast steel dewatering structure with all associated work for the preparation, handling of materials, erection of the building, installation of fans and other appurtenances, and rain water gutters and down spouts supplied under Section 13121. This item shall also include furnishing and installation of the bridge crane system (Section 14620), the elevated stairway and walkway to the upper level of the dewatering structure, signage, miscellaneous painting associated with the structure, fire extinquishers, and video and surveillance system (Section 13500). Payment shall be made based on a mutually agreed percent complete of the lump sum price for this work item.

G. Item No. 7 – Chemical Feed Structure Concrete: Payment for furnishing and installing all concrete for the new chemical storage and feed foundation, slabs, and containment walls will be made at the contract lump sum price. This item includes all labor, materials, equipment, services and incidentals necessary for all concrete work at the structure including, but is not limited to, excavation work, formwork, reinforcing steel, concrete and concrete accessories, concrete curing and finishing, concrete pads and supports, vapor barriers, and painting of the concrete surfaces. Payment shall be made based on a mutually agreed percent complete of the lump sum price for this work item.

H. Item No. 8 – Pre-Engineered Steel Chemical Feed Canopy: Payment for furnishing and installing the pre-engineered steel chemical storage and feed structure and accessories as specified under Section 13121 will be made at the contract lump sum price. This item includes all labor, materials and equipment necessary for furnishing and installing the pre-cast steel chemical storage and feed structure with all associated work for the preparation, handling of materials, erection of the building, installation of appurtenances supplied under Section 13121, and signage. Payment shall be made based on a mutually agreed percent complete of the lump sum price for this work item.

I. Item No. 9 – Centrifuge System: Payment for furnishing and installing the centrifuge system will be made at the contract lump sum price. This item includes all labor, materials and equipment necessary for furnishing and installing the centrifuge, hydraulic back drive, oil lube system, air compressor, booster pump and slab, interconnecting piping, VFDs, Centrifuge Control Panel and PLC/HMI programming, testing and placing in operation all components as specified under Section 11375. This item shall include the O&M Manuals and Training for this equipment. This item shall also include all water supply piping, air supply piping, and above slab centrate drainage and vent piping down to the lower slab and up through the roof, pipe supports, as well as all coating systems for the piping and equipment. Payment shall be made based on a mutually agreed percent complete of the lump sum price for this work item.

J. Item No. 10 – Digested Sludge Pumps and Piping: Payment for furnishing and installing the digested sludge pumps and grinders (Sections 11160 and 11432) will be made at the contract lump sum price. This item includes all labor, materials and equipment necessary for furnishing, installing, testing, and placing in operation the digested sludge pumps, grinders, concrete slab and equipment pads, suction and discharge piping up to point of connection at the centrifuge. This item shall include the O&M Manuals and Training for this equipment. This item shall also include all flush water piping, pipe supports, and all coating systems for the piping and equipment. Payment shall be made based on a mutually agreed percent complete of the lump sum price for this work item.

K. Item No. 11 – Dewatered Sludge Conveyor: Payment for furnishing and installing the dewatered sludge conveyor and truck distribution system will be made at the contract lump sum price. This item includes all labor, materials and equipment necessary for furnishing and installing the dewatered sludge conveyor and truck distribution system, ancillary components and testing as specified under Section 14554 as well as the associated cat walk assembly and all supports. This item shall include the O&M Manuals and Training for this equipment. This item shall also include all air supply piping as well as all coating systems for the piping and equipment. Payment shall be made based on a mutually agreed percent complete of the lump sum price for this work item.

L. Item No. 12 – Polymer Activation System and Piping: Payment for furnishing and installing the polymer activation system and piping will be made at the contract lump sum price. This item includes all labor, materials and equipment necessary for furnishing and installing the polymer activation system as specified in Section 11325 along with the associated piping for water supply piping, and polymer feed to points of connection on the sludge feed line, tote weigh scales, tote mixers, pipe supports, and other ancillary components and testing of the system. This item shall include the O&M Manuals and

Training for this equipment. This item shall also include all coating systems for the piping and equipment. Payment shall be made based on a mutually agreed percent complete of the lump sum price for this work item.

M. Item No. 13 – Hypochlorite Feed System and Piping: Payment for furnishing and installing the new hypochlorite feed system will be made at the contract lump sum price. This item includes all labor, materials and equipment necessary for furnishing and installing the hypochlorite tanks (Section 13209), pump skid (Section 11170), emergency eyewash, safety equipment, water supply piping, carrier pipe and yard hand holes, hypochlorite fill, vent, and feed piping, pipe supports, ancillary components and testing. This item shall include the O&M Manuals and Training for this equipment. This item shall also include all coating systems for the piping and equipment. Payment shall be made based on a mutually agreed percent complete of the lump sum price for this work item.

N. Item No. 14 – LS Submersible Pumps and Piping: Payment for furnishing and installing the replacement centrate lift station submersible pumps and discharge piping will be made at the contract lump sum price. This item includes all labor, materials and equipment necessary for furnishing and installing the centrate lift station submersible pumps (Section 11130) and discharge piping, ancillary components and testing. This section shall also include the embedded, below grade, and below slab drainage piping and manholes from the dewatering structure to the lift station. This item shall include the O&M Manuals and Training for this equipment. This item shall also include all coating systems for the piping and equipment. Payment shall be made based on a mutually agreed percent complete of the lump sum price for this work item.

O. Item No. 15 – Electrical Work: Payment for furnishing and installing the electrical modifications will be made at the contract lump sum price. This item includes all work shown on the electrical drawings and specified in Division 16. Payment shall be made based on a mutually agreed percent complete of the lump sum price for this work item.

P. Item No. 16 – Instrumentation Work: Payment for furnishing and installing the instrumentation systems will be made at the contract lump sum price. This item includes all work associated with furnishing instruments, hypochlorite control panel and PLC/HMI programming, fiber optic cable and communications, plant network modifications, and plant SCADA revisions for the new hypochlorite and dewatering process as specified in Division 17. Payment shall be made based on a mutually agreed percent complete of the lump sum price for this work item

- END OF SECTION -

SECTION 01070

ABBREVIATIONS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The following is a partial list of typical abbreviations which may be used in the Specifications, and the organizations to which they refer:

AASHTO	-	American Association of State Highway and Transportation Officials
ACI	-	American Concrete Institute
ACIFS	-	American Cast Iron Flange Standards
AFBMA	-	Anti-Friction Bearing Manufacturer's Association
AGA	-	American Gas Association
AGMA	-	American Gear Manufacturers Association
AIA	-	American Institute of Architects
AISC	-	American Institute of Steel Construction
AISI	-	American Iron and Steel Institute
ANSI	-	American National Standard Institute
API	-	American Petroleum Institute
ASCE	-	American Society of Civil Engineers
ASHRAE	-	American Society of Heating, Refrigeration, and Air Conditioning Engineers
ASME	-	American Society of Mechanical Engineers
ASTM	-	American Society for Testing and Materials
AWS	-	American Welding Society
AWWA	-	American Water Works Association
CEMA	-	Conveyor Equipment Manufacturer's Association
CRSI	-	Concrete Reinforcing Steel Institute
DIPRA	-	Ductile Iron Pipe Research Association
Fed Spec	-	Federal Specifications
IEEE	-	Institute of Electrical and Electronic Engineers
IPCEA	-	Insulated Power Cable Engineers Association
ISO	-	Insurance Services Offices
NBS	-	National Bureau of Standards
NCDOT	-	North Carolina Department of Transportation
NEC	-	National Electric Code
NEMA	-	National Electrical Manufacturers Association
OSHA	-	Occupational Safety and Health Act
PCI	-	Precast Concrete Institute
UL	-	Underwriters Laboratories, Inc.
USGS	-	United States Geological Survey

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 01090

REFERENCE STANDARDS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Titles of Sections and Paragraphs: Captions accompanying specification sections and paragraphs are for convenience of reference only, and do not form a part of the Specifications.

B. Applicable Publications: Whenever in these Specifications references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is specified, only the latest specifications, standards, or requirements of the respective issuing agencies which have been published as of the date of the opening of bids, shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes. No requirements set forth herein or shown on the Drawings shall be waived because of any provision of, or omission from, said standards or requirements.

C. Specialists, Assignments: In certain instances, Specification text requires (or implies) that specific work is to be assigned to specialists or expert entities, who must be engaged for the performance of that work. Such assignments shall be recognized as special requirements over which the CONTRACTOR has no choice or option. These requirements shall not be interpreted so as to conflict with the enforcement of building codes and similar regulations governing the Work; also they are not intended to interfere with local union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of work is recognized as "expert" for the indicated construction processes or operations. Nevertheless, the final responsibility for fulfillment of the entire set of contract requirements remains with the CONTRACTOR.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of other requirements of the specifications, all work specified herein shall conform to or exceed the requirements of all applicable codes.

B. References herein to "Building Code" shall mean the Florida Building Code (FBC). The latest edition of the code as approved and used by the local agency as of the date of the opening of bids, as adopted by the agency having jurisdiction, shall apply to the Work herein, including all addenda, modifications, amendments, or other lawful changes thereto.

C. In case of conflict between codes, reference standards, Drawings and the other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the ENGINEER for clarification and directions prior to

ordering or providing any materials or labor. The CONTRACTOR shall follow the most stringent requirements.

D. Applicable Standard Specifications: The CONTRACTOR shall construct the Work specified herein in accordance with the requirements of the Contract Documents and the referenced portions of those referenced codes, standards, and Specifications listed herein.

E. References herein to "OSHA Regulations for Construction" shall mean Title 29, Part 1926, Construction Safety and Health Regulations, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

F. References herein to "OSHA Standards" shall mean Title 29, Part 1910, Occupational Safety and Health Standards, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

-END OF SECTION-

SECTION 01200

PROJECT MEETINGS

PART 1 -- GENERAL

1.01 PRE-CONSTRUCTION MEETING

A. A Prior to the commencement of Work at the site, a pre-construction meeting will be held at a mutually agreed time and place.

B. Prior to the Preconstruction Conference, the Contractor shall have submitted and shall bring to the conference one copy of each of the following:

1. Preliminary schedule.

2. Preliminary procurement schedule of major equipment and materials and items requiring long lead time.

3. Preliminary Shop Drawing/Sample/Substitute or "Or Equal" submittal schedule.

4. Schedule of Payment Items (lump sum price breakdown) for progress payment purposes.

C. Attendance:

1. County

2. Engineer

3. Contractor

4. Major subcontractors

5. Safety representative

6. Representatives of governmental or other regulatory agencies.

C. Minimum Agenda:

1. Tentative construction schedule

2. Critical work sequencing

3. Designation of responsible personnel

4. Processing of Field Decisions and Change Orders

5. Adequacy of distribution of Contract Documents

6. Submittal of Shop Drawings and samples

7. Procedures for maintaining record documents

8. Use of site and County's requirements

9. Major equipment deliveries and priorities

10. Safety and first aid procedures

11. Security procedures

12. Housekeeping procedures

13. Processing of Partial Payment Requests

14. General regard for community relations

1.03 PROGRESS MEETING

A. Progress meetings will be held bi-weekly at the Field Office during the performance of the work of this Contract. Additional meetings may be called as progress of work dictates.

B. Engineer will preside at meetings and record minutes of proceedings and decisions. Engineer will distribute copies of minutes to participants.

C. Attendance:

1. Engineer

2. Contractor

3. Subcontractors, only with Engineer's approval or request, as pertinent to the agenda

D. Minimum Agenda:

1. Review and approve minutes of previous meetings.

2. Review progress of Work since last meeting.

3. Review proposed 30-60 day construction schedule.

4. Note and identify problems which impede planned progress.

5. Develop corrective measures and procedures to regain planned schedule.

6. Revise construction schedule as indicated and plan progress during next work period.

7. Maintaining of quality and work standards.

8. Complete other current business.

9. Schedule next progress meeting.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION –

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SECTION 01300

SUBMITTALS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. This section specifies the means of all submittals. All submittals shall be directed through the Engineer via email (or approved file share site if too large to email). A general summary of the format and types of submittals required is as follows:

Format of Submittal	Type of Submittal
digital and hard copy	Construction Schedule
digital and hard copy	Schedule of Payment Items
digital	Shop Drawings
digital and hard copy	Warranties
digital or hard copy	Certificates
actual samples	Product Samples
digital and hard copy	O&M Materials
digital	Photographs

B. At the preconstruction conference, submit a detailed list of items for which shop drawings, construction drawings, and samples will be submitted. Included in this list shall be the names of all proposed Suppliers furnishing specified items. Review of this list by the Engineer shall not relieve Contractor from submitting complete drawings and data and providing materials, equipment, etc., fully in accordance with the Contract Documents.

C. All submittals shall be submitted in digital, electronic, pdf format, other than samples. When hard copies are required, as noted above, submit the number of copies as noted herein. For all digital submittals, the Contractor shall submit one electronic copy to the Engineer via email or approved file share site. The Engineer will return one electronic file of each submittal with engineer's stamp and response comments via email or approved file share site with notification to the Contractor and County via e-mail. The Contractor shall be responsible to distribute the submittal response as needed to subcontractors impacted by each individual submittal. In the case of samples, an electronic submittal transmittal shall still be made with a description of the sample submitted with all samples delivered to an address approved by the Owner.

D. All graphical and textual-type submittals and documentation including operation and maintenance manuals shall be rendered and submitted in PDF format via email in the

latest version of Microsoft Word or Adobe Acrobat Reader format or equivalent browser based format. Graphical images shall be JPEG or equivalent browser based formats.

1.02 SUBMITTAL PROCEDURES

A. Transmit each submittal with an approved transmittal form, the enclosed material and other pertinent information specified in other parts of this section. Identify any and all variations from Contract Documents and product or system limitations which may be detrimental to successful performance of the completed Work.

B. The transmittal form shall include:
   1. the project name and address of project
   2. Owner's name and contract number
   3. Engineer's name and project number
   4. Contractor's name and job number
   5. date of submittal
   6. submittal number *
   7. description of the submittal contents and number of pages included
   8. reference to specification and/or drawing pertinent to the submittal
   9. signature of Contractor's PM indicating that the material has been reviewed by GC
   10. a blank space of at least 1/4 of the page for the Engineer's stamp.

   * The submittal number shall be in sequential, chronological order (001 through 999) with subsequent resubmittals marked 001A, 001B, etc. for any given submittal item.

C. Submittals will be returned by the Engineer as "Furnish as Submitted" (no changes required), "Furnish as Corrected" (minor corrections as noted to be furnished, no resubmittal required unless specifically noted), or "Revise and Resubmit", revise and resubmit submittal per comments made and identify all changes made on each subsequent resubmittal.

D. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions

1.03 CONSTRUCTION PROGRESS SCHEDULE

A. The Contractor shall have the capability of preparing and utilizing the specified construction progress scheduling techniques. A statement of capability shall be submitted in writing to the Engineer with the return of the executed Agreement to the County and will verify that either the Contractor's organization has in-house capability qualified to use the technique or that the Contractor employs a consultant who is so qualified. Capability shall be verified by description of the construction projects to which the Contractor or its consultant has successfully applied the scheduling technique and which were controlled throughout the duration of the project by means of systematic use and updating of the construction progress schedule, the network analysis and associated reports. The submittal shall include the name of the individual

on the Contractor's staff who will be responsible for the construction progress schedule and associated reports and for providing the required updating information of same. The Contractor shall submit its proposed progress schedule to the Engineer for review and comment within thirty days of the Notice to Award. The Engineer shall have the authority to determine acceptability/correctness of the schedule logic and activity interrelationships. The use of extraneous, nonworking activities and activities which add restraints to the construction schedule shall not be accepted. Baseline schedules that do not meet their contract completion dates shall not be accepted.

B. The Contractor's progress schedule shall be computer generated and resource loaded. Each construction progress schedule and associated report shall include the following tabulations: a list of activities in numerical order, a list of activity precedence, schedules sequenced by Early Start Date, Total Float, and Late Start Date. Each schedule and report shall include the following minimum items.

1. Activity Numbers
2. Estimated Duration
3. Activity Description
4. Early Start Date (Calendar Dated)
5. Early Finish Date (Calendar Dated)
6. Latest Allowable Start Date (Calendar Dated)
7. Latest Allowable Finish Date (Calendar Dated)
8. Status (whether critical)
9. Estimated Cost of the Activity
10. Total Float and Free Float

C. In addition, each construction progress schedule, network analysis and report shall be prefaced with the following summary data:

1. Contract Name and Number
2. Contractor's Name
3. Contract Duration and Float
4. Contract Schedule
5. The Effective or Starting Date of The Schedule (the date indicated in the Notice-to-Proceed)

D. The work day to calendar date correlation shall be based on an 8-hour day and 40-hour week with adequate allowance for holidays and all other special requirements of the Work.

E. If the Contractor desires to make changes in its method of operating which affect the construction progress schedule and related items, the Contractor shall notify the Engineer in writing stating what changes are proposed and the reason for the change. If the Engineer accepts these changes, in writing, the Contractor shall revise and submit, without additional cost to the County, all of the affected portions of the construction progress schedule, and associated reports. The construction progress schedule and related items shall be adjusted by the Contractor only after prior acceptance, in writing by the Engineer. Adjustments may consist of changing portions of the activity sequence, activity durations, division of activities, or other adjustments as may be required. The addition of extraneous, nonworking activities and activities which add restraints to the construction progress schedule shall not be accepted.

F. Except where earlier completions are specified, schedule dates which show completion of all Work prior to the contract completion date shall, in no event, be the basis for claim for delay against the County by the Contractor.

G. Construction progress schedules and related items which contain activities showing negative float or which extend beyond the contract completion date will not be accepted by the Engineer.

H. Whenever it becomes apparent from the current construction progress schedule and associated reports that delays to the critical path have resulted and the contract completion date will not be met, or when so directed by the Engineer, the Contractor shall take some or all of the following actions at no additional cost to the County. They shall submit to the Engineer for approval, a written statement of the steps they intend to take to remove or arrest the delay to the critical path in the current construction progress schedule, including a computer generated schedule revision to reflect proposed actions.

1. Increase construction manpower in such quantities and crafts as will substantially eliminate the backlog of work.

2. Increase the number of working hours per shift, shifts per day, working days per week, the amount of construction equipment, or any combination of the foregoing, sufficiently to substantially eliminate the backlog of work.

3. Reschedule activities to achieve maximum practical concurrency of accomplishment of activities, and comply with the revised schedule.

I. If so requested by the Engineer, the Contractor should fail to submit a written statement of the steps they intend to take or should fail to take such steps as reviewed and accepted in writing by the Engineer, the Engineer may direct the Contractor to increase the level of effort in manpower (trades), equipment and work schedule (overtime, weekend and holiday work, etc.) to be employed by the Contractor in order to remove

or arrest the delay to the critical path in the current construction progress schedule, and the Contractor shall promptly provide such level of effort at no additional cost to the County.

J. If the completion of any activity, whether or not critical, falls more than 100 percent behind its previously scheduled and accepted duration, the Contractor shall submit for approval a schedule adjustment showing each such activity divided into two activities reflecting completed versus uncompleted work.

K. Shop drawings which are not approved on the first submittal or within the time scheduled, and equipment which does not pass the specified tests and certifications shall be immediately rescheduled.

L. The contract time will be adjusted only in accordance with the General Requirements and other portions of the Contract Documents as may be applicable. If the Engineer finds that the Contractor is entitled to any extension of the contract completion date, the Engineer's determination as to the total number of days extension shall be based upon the current construction progress schedule and on all data relevant to the extension. Such data shall be included in the next updating of the schedule and related items. Actual delays in activities which, according to the construction progress schedule, do not affect any contract completion date will not be the basis for a change therein.

M. From time to time it may be necessary for the contract schedule of completion time to be adjusted by the Engineer in accordance with the General Requirements and other portions of the Contract Documents as may be applicable. Under such conditions, the Engineer will direct the Contractor to reschedule the Work or contract completion time to reflect the changed conditions, and the Contractor shall revise the construction progress schedule and related items accordingly, at no additional cost to the County.

N. Available float time may be used by the County through the County's Engineer.

O. The County controls the float time and, therefore, without obligation to extend either the overall completion date or any intermediate completion dates, the County may initiate changes that absorb float time only. County initiated changes that affect the critical path on the network diagram shall be the sole grounds for extending the completion dates. Contractor initiated changes that encroach on the float time may be accomplished only with the Engineer's concurrence. Such changes, however, shall give way to County initiated changes competing for the same float time.

P. To the extent that the construction project schedule, or associated report or any revision thereof shows anything not jointly agreed upon or fails to shown anything jointly agreed upon, it shall not be deemed to have been accepted by the Engineer. Failure to include on a schedule any element of Work required for the performance of this Contract shall not excuse the Contractor from completing all Work required within any applicable completion date, not withstanding the review of the schedule by the Engineer.

Q. Review and acceptance of the construction progress schedule, and related reports, by the Engineer is advisory only and shall not relieve the Contractor of the responsibility for accomplishing the Work within the contract completion date. Omissions and errors in the construction progress schedule, and related reports shall not excuse performance less than that required by the Contract and in no way make the Engineer an insurer of the Contractor's success or liable for time or cost overruns flowing from any shortcomings in the construction progress schedule, and related reports.

R. The Contractor shall present and discuss the proposed schedule at the preconstruction conference.

S. The construction progress schedule shall be based upon the precedence diagramming method of scheduling and shall be prepared in the form of a horizontal bar chart showing in detail the proposed sequence of the Work and identifying all construction activities included but not limited to yard piping, all structures and treatment units and all related Work specified herein to be performed under the Contract. The schedule shall be time scaled, identifying the first day of each week, with the estimated date of starting and completion of each stage of the Work in order to complete the project within the contract time. The project critical path shall be clearly identified in color.

T. The progress schedule shall be plotted on 22-inch by 34-inch and 11-inch by 17-inch paper and shall be revised and updated monthly, depicting progress through the last day of the current month and scheduled progress through completion. Six (two, 22-inch by 34-inch and four, 11-inch x 17-inch) up to date copies of the schedule and an electronic copy shall be submitted along with the application for monthly progress payments for the same period.

U. The construction progress schedule shall be developed and maintained using Microsoft Project, or equal.

V. The progress schedule shall be revised to reflect comments by the Engineer and updated monthly, depicting progress to the last day of the month.

W. Subsequent changes to the schedule shall be accompanied by a letter of explanation with appropriate reference and revision date on the schedule.

X. Work under the Contract shall be scheduled and performed in such a manner as to result in the least possible disruption to the operation of any of the County’s existing facilities.

Y. The existing pipelines that are to be tied into shall be maintained in an operable condition at all times by the Contractor during the entire construction duration. All work by the Contractor that disrupts the normal operations shall be shown on the Construction Schedule and specifically scheduled with the Engineer. Schedule notification shall consist of a written notice defining the work to be accomplished, the normal function that will be interrupted, the duration of the interruption, and the mitigating effort to be performed by the Contractor to maintain the system in operation. The written notice shall be submitted to the Engineer 14 days in advance of the

proposed work and the Engineer will respond to the Contractor in writing within seven days of receipt of the notice regarding the acceptability of the proposed plan.

1.04 SAMPLES

A. CONTRACTOR's samples shall be prepared, submitted, reviewed, monitored and approved in accordance with this paragraph the General Conditions.

B. Unless otherwise specified, whenever in the Specifications samples are required, the CONTRACTOR shall submit not less than two samples of each such item or material to the ENGINEER for approval at no additional cost to the COUNTY.

C. Samples, as required herein, shall be submitted for approval a minimum of fifteen working days prior to ordering such material for delivery to the jobsite and shall be submitted in an orderly sequence so that dependent materials or equipment can be assembled and reviewed without causing delays in the WORK.

D. All samples shall be individually and indelibly labeled or tagged, indicating thereon all specified physical characteristics and manufacturer's names for identification. All variances from specifications are to be marked thereon.

E. Unless otherwise specified, all colors and textures of specified items will be selected by the COUNTY from the manufacturer's standard colors and standard product lines.

F. All samples shall be of sufficient size or quantity to clearly illustrate the properties of the sample.

G. Samples shall be checked by the Contractor for conformance to the Contract Documents before being submitted to the Engineer and shall bear the Contractor's stamp certifying that they have been so checked. Transportation charges on samples submitted to the Engineer shall be prepaid by the Contractor.

H. Engineer's review will be for compliance with the Contract Documents, and its comments will be transmitted to the Contractor with reasonable promptness.

I. Acceptable samples will establish the standards by which the completed Work will be judged.

1.05 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall submit electronic files for draft Operations and Maintenance (O&M) Manuals for each item of equipment within 30 days of receipt of the approved submittal made for each item of equipment or material submitted for review. Manuals are to include all information included in the approved Shop Drawings along with the additional information listed herein. The draft manuals shall be reviewed by the COUNTY and the ENGINEER and returned with comments to the CONTRACTOR for revision. Revisions will be incorporated into the Final Operation and Maintenance Manuals to be submitted.

B. The Contractor shall furnish and deliver to the Engineer six (6) complete and final Operation and Maintenance (O&M) Manuals for the substantial, complete systems including instructions, technical bulletins, and any other printed matter such as diagrams, prints or drawings, containing full information required for the proper operations, maintenance, and repair of all Contractor furnished equipment. The final manuals shall incorporate all Engineer's review comments associated with the preliminary O&M Manual. Also included shall be a spare parts diagram and complete spare parts list. These requirements are a prerequisite to the operation and acceptance of equipment. Each O&M Manual shall be bound together in appropriate three-ring vinyl plastic hard cover binders. Binder ring size shall not exceed 2.5 inches. A detailed table of contents shall be provided for each Manual and tabbed section dividers shall be included for each type of equipment with section number and name printed on the tab. Provide an appropriate label on the binder edge. Provide subtabs and separate sections for operation, maintenance, spare parts, etc for each equipment section. Front covers and binder edge covers shall reference the facility and project name as directed by the Engineer. Each front and binder edge cover shall include, as a minimum, the Lee County logo (electronic file of logo to be provided to Contractor by County/Engineer), Project Name, Date (Month/Year), Equipment Name, and the corresponding Specification Section Number.

C. Written operations and maintenance instructions are required for all equipment items supplied for this project. The amount of detail shall be commensurate with the complexity of the equipment item. Extensive pictorial cuts of equipment are required for operator reference in servicing.

D. Information not applicable to the specific piece of equipment installed on this project shall be struck from the Manual by the Contractor. Information provided shall include a source of replacement parts and names of service representatives, including addresses and telephone numbers.

E. When written instructions include shop drawings and other information previously reviewed by the Engineer, only those editions which were accepted by the Engineer, and which accurately depict the equipment installed, shall be incorporated in the O&M Manual.

F. The technical manuals shall include for each item of mechanical and electrical equipment:

1. Complete operating instructions, including location of controls, special tools or other equipment required, related instrumentation, and other equipment needed for operation.

2. Lubrication schedules, including the lubricant SAE grade and type, temperature range of lubricants, and frequency of required lubrication.

3. Preventive maintenance procedures and schedules.

4. Parts lists by generic title and identification number complete with exploded views

of each assembly.

5. Disassembly and reassembly instructions.

6. Name and location of nearest supplier and spare parts warehouse.

7. Recommended troubleshooting and start-up procedures.

8. Reproducible prints of the record drawings, including diagrams and schematics, as required under the electrical and instrumentation portions of these specifications (if any).

G. The CONTRACTOR shall submit the required final manuals complete and in the number and fashion specified prior to requesting payment in excess of seventy-five percent of the base contract value. Failure to do so shall be cause for the COUNTY to withhold any further payments to the CONTRACTOR until the requirements of this paragraph are met.

H. Electronic File Copies: Once the hard copy of the operation and maintenance manuals have been submitted, approved, and accepted, the CONTRACTOR shall digitally scan all contents of the manuals to provide tif or pdf files of the documents suitable for development of an electronic on-line manual. Digital file copies shall be made available to the CONTRACTOR's instrumentation subcontractor responsible for Citect programming who shall then use the files to create the on-line manual as specified under Division 17. Provide six copies of the electronic files on six separate CD/DVDs.

1.06 SPARE PARTS LISTS

A. The CONTRACTOR shall furnish to the ENGINEER a list of spare parts as specified herein. The spare parts list shall include the current list price of each spare part. The spare parts list shall be limited to those spare parts which are being supplied under this Contract along with additional spare parts each manufacturer recommends be maintained by the COUNTY in inventory at the plant site. Each manufacturer or supplier shall indicate the name, address, and telephone number of its nearest outlet of spare parts to facilitate the COUNTY in ordering. The CONTRACTOR shall cross-reference all spare parts lists to the equipment numbers designated in the specifications or on the drawings.

B. The CONTRACTOR shall submit the required spare parts lists complete and in the number and fashion specified prior to requesting payment in excess of seventy-five percent of the base contract value. Failure to do so shall be cause for the COUNTY to withhold any further payments to the CONTRACTOR until the requirements of this paragraph are met.

1.07 RECORD DRAWINGS - GENERAL

A. The CONTRACTOR shall record actual construction activity on a regular basis on a clean set of contract drawings throughout the course of the work to accurately reflect the

work done. Deviations or additional information from that shown on the contract drawings shall be recorded on the record drawing set using red ink for additions and green ink for deletions.

B. CONTRACTOR's record drawings shall be maintained in accordance with the General Conditions, all specific directions in the specifications, and the Supplemental Conditions.

C. On the Record drawings, the CONTRACTOR shall mark all project conditions, locations, configurations, and any other changes or deviations which may vary from the details represented on the original Contract Drawings, including buried or concealed construction and utility features which are revealed during the course of construction. Special attention shall be given to recording the horizontal and vertical location of all buried utilities that differ from the locations indicated or which were not indicated on the Contract Drawings. Said record drawings shall be supplemented by any detailed sketches or typewritten changes to the specifications, as necessary or directed to indicate fully the WORK as actually constructed. The record drawings of the CONTRACTOR's representation of as-built conditions, including all revisions made necessary by addenda, change orders, and the like shall be maintained up-to-date during the progress of the WORK.

D. In the case of the drawings which depict the detail requirements for equipment to be assembled as wired in the factory, such as motor control centers and the like, the record drawings shall be updated by indicating those portions which are superseded by change order drawings or final shop drawings and by including appropriate reference information describing the change orders by number and the shop drawings by manufacturer, drawing, and revision numbers.

E. Record drawings shall be accessible to the ENGINEER or the PROFESSIONAL at all times during the construction period.

F. Applications for Payment will not be approved if the record drawings are not kept current and not until the completed record drawings showing all variations between the WORK as actually constructed and as originally shown on the Contract Drawings or other Contract Documents have been inspected and accepted by the ENGINEER or PROJECT REPRESENTATIVE.

G. The CONTRACTOR shall submit, with the final pay request, the completed set of record drawings for use by the ENGINEER in producing the final electronic file copies for the permanent record drawing file delivered to the COUNTY. The record drawing set shall be in good condition and completely legible.

H. The final pay request shall not be accepted by the COUNTY inspector until the blueline copy of the Record Drawings is approved by the ENGINEER.

1.08 RECORD DRAWINGS MINIMUM REQUIREMENTS

A. All as-built conditions must be noted as follows:

1. Buried valves, fittings, plugs and caps, taps for disinfection and testing, and air

release valve assemblies. Locate by survey using state plane coordinate system for horizontal location and by elevation to top of fitting or valve.

2. Invert elevation of all gravity stubouts for future connections, including terminal point.

3. Limits, dimensions, and depth of concrete encasing, encasing pipe and sheeting.

4. Horizontal and vertical locations of other public and private utilities when they are encountered during construction.

5. Indicate size, type, depth, location, and limits of any pipe that is abandoned as part of the work or any existing pipe that is crossed by new piping as part of the work. Include type of abandonment (i.e. end plug, mortar filled, etc.) for abandoned pipe.

6. Certified survey of the location of all new structures in relation to the property boundaries and other existing structures. Indicate location of all underground pipe and duct bank at point of connection to structures. Locate from corner or centerline of structure.

7. Storm Drains, Inlets, and Structures: Location for all catchbasins, manholes, and other structures. Elevations of grates, throats, weirs, and orifices. Invert elevations for all pipes and structures. Pipe size, type, material, slope, and distance between structures.

8. Roadway: Elevations of all roadway vertical control points and terminations of curb returns.

B. All changes and significant deviations from the original design plans must be included as described below:

1. High and low pipeline points, service taps, restrained joints, and fire hydrants.

2. Pipe diameter and material, including services.

3. Beginning and end points where pipe joints are significantly deviated to avoid a conflict, including the depth of cover.

4. Gravity Sewers: Station number of all manholes and services (i.e. wyes, etc.). Elevations for top of manholes and pipe inverts. Pipe size, type, slope, and distance between manholes.

5. Plants/Pump Stations: All of the items below ground level including electrical ducts, etc.

C. All deviations must be highlighted on the record drawings using a "cloud". If any revisions to the original plans required a Change Order, the "cloud" shall include the Change Order number.

* A significant deviation is defined as follows:

1. Horizontal - 1 foot or one half the diameter of the pipe, whichever is less.

2. Vertical - More than 6 inches for pressure pipelines. More than 1 inch for gravity pipelines.

1.09 EXCAVATION PLAN

A. CONTRACTOR shall prepare and submit an excavation plan for the WORK contained in the Contract prior to beginning any excavations. The plan shall incorporate all OSHA regulations (29CFR1926 Subpart P) and include a general plan for performing excavation, ground dewatering, sheeting, shoring and bracing, haul routes for the disposal of surface materials and for transporting excess excavation materials to either (1) a disposal site chosen by the CONTRACTOR when excess excavated materials are designated to become the property of the CONTRACTOR or (2) the storage area designated by the Contract Documents when the excess excavated materials are designated to remain the property of the COUNTY. The excavation plan is for the COUNTY's information only. Submission and acceptance by the COUNTY of this information shall not relieve the CONTRACTOR from constructing the WORK in a continuous safe manner at all times and in accordance with the Contract Documents.

1.10 SUBMITTAL OF PROPOSED EQUIVALENT PRODUCTS

A. The review of all materials, processes or equipment offered as equivalent to that indicated or specified in the Contract Documents shall be in accordance with the Instructions to Bidders and the General and Special Conditions.

1.11 PROGRESS REPORTS

A. A progress report shall be furnished to PROJECT REPRESENTATIVE with each Application for Payment. If the WORK falls more than 15% behind schedule, CONTRACTOR shall submit additional progress reports at such intervals as PROJECT REPRESENTATIVE may request.

B. Each progress report shall include sufficient narrative to describe any current and anticipated delaying factors, their effect on the construction schedule, and proposed corrective actions. Any WORK reported complete, but which is not readily apparent to ENGINEER, must be substantiated with satisfactory evidence.

C. Each progress report shall include a list of the activities completed with their actual start and completion dates, a list of the activities currently in progress, a list of critical activities including float, and the number of days required to complete each.

1.12 DAILY FORCE REPORT

A. CONTRACTOR shall submit to the PROJECT REPRESENTATIVE a daily force report. The report shall be delivered not later than 8 a.m. of the work day following the report day and shall include the following:

1. Day of week, date, CONTRACTOR name, and Report number.

2. Summary of WORK in process (segregated by CONTRACTOR and subcontractor and distinguish each item by associated CIP number).

3. Details of WORK accomplished including quantities of WORK installed.

4. Summary of equipment working and where working.

5. Summary of manpower by WORK element and subcontractor.

6. Receipt of major equipment or materials.

1.13 EROSION AND POLLUTION CONTROL PLAN

A. The CONTRACTOR shall prepare and submit to the COUNTY a special plan for the prevention, control and abatement of erosion and water pollution.

B. This plan shall be prepared in accordance with the general requirements and/or any special requirements of all permits which authorize construction of the project. In the event the permits do not specifically address erosion and water pollution or they do not contain special conditions relating to erosion and water pollution, the project erosion control plan shall be governed by Section 02276 of these contract documents and the requirements below.

C. The erosion control plan shall be prepared in accordance with the CONTRACTOR's proposed sequence of operations and shall describe but not be limited to the following items or activities:

D. For each phase of construction operations or activities the CONTRACTOR shall supply the following information:

1. Locations of all erosion control devices.

2. Types of all erosion control devices.

3. Estimated length of time erosion control devices will be in operation.

4. Monitoring schedules for maintenance of erosion control devices.

5. Methods of maintaining erosion control devices.

6. Methods of containment or removal of pollutants or hazardous wastes.

E. The CONTRACTOR shall furnish the ENGINEER the name and telephone number of the person who will be responsible for monitoring and maintaining the erosion control devices.

F. The CONTRACTOR shall be responsible for submitting a copy of the erosion control plan to the Southwest Florida Water Management District Office stated in the special conditions of the approved SWFWMD permit. The data submitted to the appropriate SWFWMD office shall include the SWFWMD permit number on all correspondence.

1. Copies of the erosion control plan shall also be submitted to the COUNTY.

2. No construction activities shall commence until the erosion control plan has been reviewed and written approval received from the Southwest Florida Water Management District.

G. The CONTRACTOR shall be responsible for compliance with the approved erosion control plan.

1.14 SHOP DRAWINGS

A. The Contractor shall submit a detailed Schedule of Shop Drawing Submittals at the Pre-Construction Conference, organized by Specification Section Number. The Submittal Schedule shall include all submittals the Contractor intends to make, including any anticipated subsequent submittals on any particular item. The schedule shall indicate the expected date the submittal (or resubmittal) is expected to be made and the date the submittal (or resubmittal) is required to be returned by the Engineer. The schedule should indicate the expected delivery time for the equipment after receiving approval related to each submittal and the date the equipment is needed to be delivered to the site to meet the proposed construction schedule.

B. The Contractor shall submit for review shop drawings for concrete reinforcement, structural details, piping layout and appurtenances, wiring, color selection charts, Contractor Furnished Equipment, materials and equipment fabricated especially for this Contract, and materials and equipment for which such Drawings are specified or specifically requested by the Engineer.

C. Shop drawings shall show the principal dimensions, weight, structural and operating features, space required, clearances, type and/or brand of finish or shop coat, grease fittings, installation/erection drawings, etc., depending on the subject of the Drawings.

D. When so specified, or if considered by the Engineer to be acceptable, the manufacturer's specifications, catalog data, descriptive matter, illustrations, etc. may be submitted for review in place of shop drawings. In such case, the requirements shall be as specified for shop drawings, insofar as applicable.

E. The Contractor shall be responsible for the prompt submittal of all submittals and shop drawings so that there shall be no delay to the Work due to the absence of or late submittal on any item requiring submittals for approval. The Engineer will review a submittal within 21 calendar days of receipt of that submittal. Reviewed submittals will be returned to the Contractor by regular mail, posted no later than 21 days after receipt.

F. Rejected Submittals: Time delays caused by rejection of submittals are not cause for extra charges to the County or time extensions. The Contractor is expected to submit an approvable re-submittal on the second submittal for any particular item, if that items initial submittal was not approved. If a third submittal (second re-submittal) is required for any particular item, the Contractor may be required to pay the Engineer's costs for the review of that, and any subsequent submittals. The COUNTY reserves the right to withhold monies due to the CONTRACTOR to cover additional costs of review of re-submittals beyond the second re-submittal.

G. Requirements: All submittals shall be delivered to the Engineer by the Contractor. The Contractor is responsible for obtaining submittals from subcontractors and returning reviewed submittals to them. All submittals shall be clearly marked with the name of the project, County, Contractor, and building, equipment, or structure to which the submittal applies. Submittals shall be suitably numbered by specification number and sequential number and stamped by the Contractor. Each shipment of submittals shall be accompanied by a letter of transmittal noting the information listed herein. A copy of each submittal transmittal letter shall be sent to the PROJECT REPRESENTATIVE.

H. Product Data: Where manufacturer's publications in the form of catalogs, brochures, illustrations, or other data sheets are submitted in lieu of prepared shop drawings, such submission shall specifically indicate the particular item offered. Identification of such items and relative pertinent information shall be made with indelible ink. Submissions showing only general information will not be accepted. Non-applicable information shall be crossed out.

I. Product data shall include materials of construction, dimensions, performance characteristics, capacities, wiring diagrams, piping and controls, etc.

J. Warranties: When warranties are called for, a sample of the warranty shall be submitted with the shop drawings. The sample warranty shall be the same form that will be used for the actual warranty. Actual warranties shall be originals and notarized.

K. Work Prior to Review: No material or equipment shall be purchased, fabricated especially for this Contract, or delivered to the project site until the required shop drawings have been submitted, processed and marked either "FURNISH AS SUBMITTED" or "FURNISH AS CORRECTED". All materials and Work involved in the construction shall be as represented by said Drawings.

L. The Contractor shall not proceed with any portion of the Work (such as the construction of foundations) for which the design and details are dependent upon the design and details of equipment for which submittal review has not been completed.

M. Contractor's Review: Only submittals which have been checked and corrected should be submitted to the Contractor by its subcontractors and vendors. Prior to submitting shop drawings to the Engineer, the Contractor shall check thoroughly all such Drawings to satisfy itself that the subject matter thereof conforms to the Drawings and Specifications in all respects. Drawings which are correct shall be marked with the date, checker's name and indications of the Contractor's approval, and then shall be submitted to the Engineer. Other Drawings submitted to the Engineer will be returned to the Contractor unreviewed.

N. Contractor's Responsibility: The Engineers review of shop drawings will be general and shall not relieve the Contractor of the responsibility for details of design, dimensions, etc., necessary for proper fitting and construction of the Work required by the Contract and for achieving the specified performance.

O. Contractor's Modifications: For submissions containing departures from the Contract Documents, the Contractor shall include proper explanation in his letter of transmittal. Should the Contractor submit for review equipment that requires modifications to the structures, piping, layout, etc. detailed on the Drawings, he shall also submit for review details of the proposed modifications. If such equipment and modifications are accepted, the Contractor, at no additional cost to the County, shall do all Work necessary to make such modifications.

P. "Or Equal" Items: Whenever a particular brand or make of material, equipment, or other item is specified, or is indicated on the Drawings, it is for the purpose of establishing a standard of quality, design, and type desired and to supplement the detailed specifications and unless it is followed by the words "NO SUBSTITUTION", or “SUBSTITUTIONS ARE NOT ALLOWED” any other brand or make which is equivalent to that specified or indicated may be offered as an "or equal" item subject to the following provisions:

1. Contractor shall submit for each proposed "or equal" item sufficient details, complete descriptive literature, and performance data together with samples of the materials, where feasible, to enable the Engineer to determine if the proposed "or equal" item is equal, in all respects including, but not limited to, quality, performance, ease of maintenance, availability of spare parts, and experience record.

2. Contractor shall submit certified tests, where applicable, by an independent laboratory attesting that the proposed "or equal" item is equal.

3. A list of installations where the proposed "or equal" item is equal. Such listing shall cover a minimum of the previous five years and will furnish project names and contact phone numbers.

4. Where the acceptance of a "or equal" item requires excessive review by the Engineer, revision or redesign of any part of the Work, all such additional review costs, revisions and redesign, and all new Drawings and details required therefore, shall be at the Contractor's expense.

5. In all cases the Engineer shall be the sole judge as to whether a proposed "or equal" item is to be accepted. The Contractor shall abide by the Engineer's decision when proposed "or equal" items are judged to be unacceptable and shall in such instances furnish the item as specified. No "or equal" items shall be used in the Work without written acceptance of the Engineer.

6. Acceptance of any proposed "or equal" item shall in no way release the Contractor from any of the provisions of the Contract Documents.

7. County may require, at Contractor's expense, a special performance guarantee or other surety with respect to any substitute.

Q. Complete Submittals: Each submittal shall be complete in all aspects incorporating all information and data required to evaluate the products' compliance with the Contract Documents. Partial or incomplete submissions shall be returned to the Contractor without review.

R. Structural Shop Drawings

1. General: Following are additional requirements for structural shop drawings.

2. Fabricated items: Submit prints of all structural shop drawings of fabricated items such as reinforcing, structural steel, aluminum, gratings, floor plates, handrails, stairs, etc. The reproducible copy will be returned to the Contractor for duplication and required further distribution. All proposed changes shall be clearly clouded and flagged for Engineer’s review and acceptance.

3. Coordination and Verification: Prior to submission the Contractor shall coordinate the shop drawings with related trades and verify that the required dimensions or information necessary for construction has been made.

4. Facility shop drawings: For each facility reinforcing or structural steel shop drawings such as rebars for footings, base slab, columns, beams, stairs, etc., shall all be submitted at one time.

5. Concrete Products & Accessories: Submittals of all concrete related products and accessories shall be made all at one time, each properly labeled and its use identified by Facility/Structure name.

1.15 WARRANTIES

A. Warranties called for in the Contract Documents shall be originals and submitted to the County through the Engineer. When warranties are required they shall be submitted prior to request for payment.

B. When advance copies of warranties are requested, they shall be submitted with, and considered as shop drawings. Warranties shall be submitted digitally.

1.16 CERTIFICATES

A. Certifications and test reports shall be submitted for requested items to the Engineer prior to request for payment for associated items. Certificates shall be submitted digitally.

1.17 CONSTRUCTION PHOTOGRAPHS

A. Construction Photographs Required

1. Photographs shall be taken daily on all major activities of the work prior to beginning the work and after the work is completed. Contractor shall discuss with the PROJECT REPRESENTATIVE what photos are to be taken each day.

2. Views and Quantities Required

a. Two (2) views of each activity, one before and one after completion of work.

b. Provide one electronic digital file copy of each view

c. Submit construction photograph digital files on CD on a weekly basis on the Monday following the week photos are taken. Update digital file copy set on a daily basis.

B. File name of each digital file shall include the date the photo was taken. Photos shall be in color and have high resolution and sharpness.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION –

SECTION 01385

COLOR AUDIO-VIDEO CONSTRUCTION RECORD

PART 1 - GENERAL

1.01 SCOPE

A. Prior to the commencement of any work, including CONTRACTOR mobilization, the CONTRACTOR shall have a continuous color digital audio-video recording taken of the interior and exterior areas of any areas of the existing wastewater plant site that are likely to be impacted by construction activities. The audio-video record is to serve as a record of preconstruction conditions. The recording shall be suitable for viewing on standard laptop and/or desk top computers used by the Engineer, County, and PROJECT REPRESENTATIVE. Two copies of the recording shall be kept at the temporary construction office, one with the PROJECT REPRESENTATIVE and one with the Contractor until completion of the work at which time at least one copy shall be turned over to the County.

1.02 CONSTRUCTION SCHEDULE

A. Digital recordings shall not be made more than 30 days prior to construction in any area. No construction shall begin prior to review and approval of the digital recordings, covering the construction area, by the Engineer. The Engineer shall have the authority to reject all or any portion of the digital recording not conforming to the specifications and order that it be redone at no additional charge. The Contractor shall reschedule unacceptable coverage within five (5) days after being notified. The Engineer shall designate those areas, if any, to be omitted from or added to the audio-video coverage. All master digital copies and written records shall be well maintained without any damage and shall become the property of the County.

1.03 PROFESSIONAL VIDEO-GRAPHERS

A. The Contractor shall engage the services of a professional videographer. The color audio-video digital recordings shall be prepared by a responsible commercial firm known to be skilled and regularly engaged in the business of pre-construction color audio-video digital documentation. The videographer shall furnish to the Engineer a list of all equipment to be used for the audio-video recording, i.e., manufacturer's name, model number, technical specifications and other pertinent information. Additional information to be furnished by the videographer shall include the names and addresses of two (2) references that the videographer has performed color audio-videotaping for on projects of a similar nature, including one (1) within the last twelve (12) months.

PART 2 - PRODUCT

2.01 GENERAL

A. The total audio-video digital recording system and the procedures employed in its use shall be such as to produce a finished product that will fulfill the technical requirements of the project. The video portion of the recording shall produce bright, sharp, and clear pictures with accurate colors and shall be free from distortion or any other form of picture imperfection. All video recordings shall, by electronic means, display on the screen the day, the time, the month, and the year of the recording. This date and time information must be continuously and simultaneously generated with the actual recording. The audio portion of the recording shall produce the commentary of the camera operator with proper volume, clarity, and be free from distortion.

2.02 EQUIPMENT

A. Audio/Video Recorder: Digital voice and video recorder, MPEG-4 recording technology for TV quality video recording, built-in microphone for high quality voice and sound recording, 3.15 Mega Pixel CDD Sensor with up to 640x480 video resolution, 4X digital zoom, 16MB internal memory, SD/MMC compatible, compatible with software needed and cabling provided to interface with a Windows 10 based computer for creating high quality digital file records.

B. Video Storage Devices: Used to create and store digital video, audio and multimedia files. Stores up to 4.7GB or more than two hours of MPEG2 Video, compatible for playback with most Windows 10 based computers. The storage devices shall be new and shall not have been used for any previous recording.

PART 3 - EXECUTION

3.01 COVERAGE

A. The recordings shall contain coverage of all surface features located within the construction areas and shall include but not be limited to: all roadways, pavements, detention ponds, ditches, walls, piping, equipment, curbs, driveways, sidewalks, culverts, headwalls, retaining walls, buildings, landscaping, trees, shrubbery, fences, and electrical power poles and equipment. Of particular concern shall be the existence of any faults, fractures, or defects.

B. Recording coverage shall be grouped by structure providing both exterior and interior coverage for all areas that will be affected by the work. The outside areas of the work for the general area grounds shall be covered in grid format to cover the property for the construction areas that will be affected by the work. Coverage shall include all surface conditions located within the zone of influence of construction supported by appropriate audio description.

3.02 AUDIO CONTENT

A. Accompanying the video recording shall be a corresponding and simultaneously recorded audio recording. This audio recording, exclusively containing the commentary of the camera operator, shall assist in viewer orientation and in any needed identification, differentiation, clarification, or objective description of the features being shown in the video portion of the recording including the location relative to construction activities planned. The audio recording shall be free from any conversations between the camera operator and any other production technicians. Panning, zoom-in and zoom-out rates shall be sufficiently controlled to maintain a clear view of all subjects.

3.03 VIDEO LOGS

A. Video Logs: Each video recording digital file shall have a log of that video recording's contents and what the recording file is stored on. The log shall describe the various segments of coverage contained on that video recording in terms of the location within the plant, extent of coverage, beginning and end points, directions of coverage, and date.

3.04 TIME OF EXECUTION

A. Visibility: All recording shall be performed during times of good visibility. No recording shall be done during periods of significant precipitation, mist, or fog. The recording shall only be done when sufficient sunlight is present for outdoor recordings to properly illuminate the subject, and to produce bright, sharp video recordings of those subjects. For indoor recordings, the CONTRACTOR shall provide adequate lighting to produce bright, sharp video recordings. No recording shall be performed when more than 10% of the area to be recorded contains debris or obstructions unless otherwise authorized by the Engineer.

3.05 CONTINUITY OF COVERAGE

A. In order to increase the continuity of the coverage, the coverage shall consist of a single, continuous, unedited recording which begins at one end of a particular construction area and proceeds uninterrupted to the other end of that area. Coverage shall reflect an organized, interrelated sequence of recordings from one construction area to another. Coverage shall be obtained by walking or by other conveyance approved by the Engineer.

3.06 COVERAGE RATES

A. The rate of travel during a particular segment of coverage shall be related to the amount of the surface features within a construction area being recorded. For interior and exterior of existing structures, average rate of travel shall not exceed thirty feet per minute from approximately 10 feet from subject. For open areas within the existing plant, average rate of travel shall not exceed forty-eight feet per minute. For open areas within the new property area, average rate of travel shall not exceed sixty feet per minute

3.07 CAMERA OPERATION

A. Camera Stability: Camera shall be firmly held such that movement of the camera during the recording process does not cause an unsteady picture.

B. Camera Control: Camera pan, tilt, zoom-in, and zoom-out rates shall be sufficiently controlled such that recorded objects will be clearly viewed during video playback. In addition, all other camera and recording system controls such as lens focus and aperture, video level, pedestal, chroma, white balance, and electrical focus shall be properly controlled or adjusted to maximize picture quality.

C. Viewer Orientation Techniques: The audio and video portions of the recording shall maintain viewer orientation. To this end overall establishing views and visual displays of all visible building distinguishing characteristics shall be incorporated at the beginning of each recording. The narrator shall regularly call out changes in direction, viewing angle, focus zoom, and distinguishing subjects as the video recording progresses.

D. Operator Experience: The operator in charge must have had previous experience with audio-video documenting preconstruction work. Any apprentice operator(s) must be continuously supervised by an experienced operator.

3.07 VIDEO VIEWING

A. The video recordings shall be suitable for playing video and audible recordings on standard computer desktop or laptop computers.

- END OF SECTION -

SECTION 01400

QUALITY CONTROL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Testing Laboratory Services

1. Laboratory testing and checking required by the Specifications, including the cost of transporting all samples and test specimens, shall be provided and paid for by the CONTRACTOR unless otherwise indicated in the Specifications.

2. Materials to be tested include, but are not necessarily limited to the following: cement, concrete aggregate, concrete, bituminous paving materials, structural and reinforcing steel, select backfill, crushed stone or gravel, sand, and compaction density testing. The CONTRACTOR shall employ the services of independent laboratories or material testing firms to perform all tests as specified in the Contract Documents.

3. The CONTRACTOR shall supple test results and certificates from manufacturers or suppliers to demonstrate conformance with the Specifications.

4. Procedure

a. The CONTRACTOR shall plan and conduct his operations to permit taking of field samples and test specimens, as required, and to allow adequate time for laboratory tests.

b. The collection, field preparation and storage of field samples and test specimens shall be as directed by the selected independent laboratories with the cooperation of the CONTRACTOR.

5. Significance of Tests

a. Test results shall be binding on the CONTRACTOR and shall be considered irrefutable evidence of compliance or noncompliance with the Specification requirements, unless supplementary testing shall prove, to the satisfaction of the COUNTY, that the initial samples were not representative of actual conditions.

6. Supplementary and Other Testing

a. Nothing shall restrict the CONTRACTOR from conducting tests he may require. Should the CONTRACTOR, at any time, request the COUNTY to consider such test results, the test reports shall be certified by an independent testing laboratory acceptable to the COUNTY. Testing of

this nature shall be conducted, following notification to the Engineer and COUNTY, at the CONTRACTOR's expense.

1.02 FIELD TESTING OF EQUIPMENT

A. All equipment shall be set, aligned and assembled in conformance with the manufacturer's drawings and instructions.

B. Preliminary Field Tests, Yellow Tag

1. As soon as conditions permit, after the equipment has been secured in its permanent position, the CONTRACTOR shall check the equipment for alignment, direction of rotation, and that it is free from defects.

2. CONTRACTOR shall flush all bearings, gear housings, etc., in accordance with the manufacturer's recommendations, to remove any foreign matter accumulated during shipment, storage, or erection. Lubricants shall be added as required by the manufacturer's instructions.

3. When the CONTRACTOR has demonstrated to the ENGINEER that the equipment is ready for operation, a yellow tag will be issued. The tag will be signed by the ENGINEER or his assigned representative and attached to the equipment. The tag shall not be removed.

4. Preliminary field tests, yellow tag, must be completed before equipment is subjected to final field tests, blue tag.

C. Final Field Tests, Blue Tag

1. Upon completion of the installation, and at a time approved by the ENGINEER, equipment will be tested by operating it as a unit with all related piping, ducting, electrical controls, and mechanical operations.

2. The equipment will be placed in continuous operation as prescribed or required and witnessed by the ENGINEER or his assigned representative and the COUNTY or his assigned representative.

3. The tests shall prove that the equipment and appurtenances are properly installed, meet their operating cycles, and are free from defects such as overheating, overloading, and undue vibration and noise. Equipment shall be tested for the characteristics as specified for the item.

4. Each pump shall be tested at maximum rated speed for at least four (4) points on the pump curve for capacity, head and electric power input. The rated motor nameplate current and power shall not be exceeded at any point within the specified range. Vibrometer readings shall be taken when directed by the ENGINEER and the results recorded. Additional tests shall be performed as prescribed in other sections of the Specifications.

5. Pumps with drive motors rated at less than five (5) horsepower shall only be tested for excess current or power when overheating or other malfunction becomes evident in general testing.

6. Until final field tests are acceptable to the ENGINEER, the CONTRACTOR shall make all necessary changes, readjustments and replacements at no additional cost to the COUNTY.

7. Defects which cannot be corrected by installation adjustments will be sufficient grounds for rejection of any equipment.

8. Upon acceptance of the field tests, a blue tag will be issued. The tag will be signed by the ENGINEER and attached to the unit. The tag shall not be removed and no further construction work will be performed on the unit, except as required during start-up operations and directed by the ENGINEER.

9. All costs in connection with such tests including all materials, equipment, instruments, labor, etc., shall be borne by the CONTRACTOR.

1.03 IMPERFECT WORK, EQUIPMENT, OR MATERIALS

A. Any defective or imperfect work, equipment, or materials furnished by the CONTRACTOR which is discovered before the final acceptance of the work, as established by the Certificate of Substantial Completion, or during the subsequent guarantee period, shall be removed immediately even though it may have been overlooked by the ENGINEER and estimated for payment. Any equipment or materials condemned or rejected by the ENGINEER shall be tagged as such and shall be immediately removed from the site. Satisfactory work or materials shall be substituted for that rejected.

B. The ENGINEER may order tests of imperfect or damaged work, equipment, or materials to determine the required functional capability for possible acceptance, if there is no other reason for rejection. The cost of such tests shall be borne by the CONTRACTOR; and the nature, tester, extent, and supervision of the tests will be as determined by the ENGINEER. If the results of the tests indicate that the required functional capability of the work, equipment, or material was not impaired, consistent with the final general appearance of same, the work, equipment, or materials may be deemed acceptable. If the results of such tests reveal that the required functional capability of the questionable work, equipment, or materials has been impaired, then such work, equipment, or materials shall be deemed imperfect and shall be replaced. The CONTRACTOR may elect to replace the imperfect work, equipment, or material in lieu of performing the tests.

1.04 INSPECTION AND TESTS

A. The CONTRACTOR shall allow the ENGINEER ample time and opportunity for testing materials and equipment to be used in the work. CONTRACTOR shall advise the ENGINEER promptly upon placing orders for material and equipment so that arrangements may be made, if desired, for inspection before shipment from the place of manufacture. The CONTRACTOR shall at all times furnish the ENGINEER and his

representatives, facilities including labor, and allow proper time for inspecting and testing materials, equipment, and workmanship. The CONTRACTOR must anticipate possible delays that may be caused in the execution of his work due to the necessity of materials and equipment being inspected and accepted for use. The CONTRACTOR shall furnish, at his own expense, all samples of materials required by the ENGINEER for testing, and shall make his own arrangements for providing water, electric power, or fuel for the various inspections and tests of structures and equipment.

B. The CONTRACTOR shall furnish the services of representatives of the manufacturers of certain equipment, as prescribed in other Sections of the Specifications. The CONTRACTOR shall also place his orders for such equipment on the basis that, after the equipment has been tested prior to final acceptance of the work, the manufacturer will furnish the COUNTY with certified statements that the equipment has been installed properly and is ready to be placed in functional operation. Tests and analyses required of equipment shall be paid for by the CONTRACTOR, unless specified otherwise in the Section which covers a particular piece of equipment.

C. Where other tests or analyses are specifically required in other Sections of these Specifications, the cost thereof shall be borne by the party (COUNTY or CONTRACTOR) so designated in such Sections. The COUNTY will bear the cost of all tests, inspections, or investigations undertaken by the order of the ENGINEER for the purpose of determining conformance with the Contract Documents if such tests, inspection, or investigations are not specifically required by the Contract Documents, and if conformance is ascertained thereby. Whenever nonconformance is determined by the ENGINEER as a result of such tests, inspections, or investigations, the CONTRACTOR shall bear the full cost thereof or shall reimburse the COUNTY for said cost. In this connection, the cost of any additional tests and investigations, which are ordered by the ENGINEER to ascertain subsequent conformance with the Contract Documents, shall be borne by the CONTRACTOR.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

3.01 BUOYANCY

A. The CONTRACTOR shall be completely responsible for any tanks, pipelines, manholes, foundations or similar improvements that may become buoyant during the construction operations due to groundwater levels. Should there be any possibility of buoyancy, the CONTRACTOR shall take the necessary steps to prevent damage due to floating or flooding, and shall repair or replace said improvements at no additional cost to the COUNTY.

- END OF SECTION -

SECTION 01510

TEMPORARY UTILITIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. General: In addition to the requirements for utilities specified in Section 01520 for temporary offices, it shall be CONTRACTOR's responsibility to provide temporary utilities that are adequate for the performance of the WORK under this Contract within the time specified. All temporary utilities shall be kept in satisfactory operating condition, capable of safely and efficiently performing the required function, and are subject to inspection and approval by COUNTY at any time for the duration of the Contract. All WORK hereunder shall conform to the applicable requirements of the OSHA Standards for Construction.

B. The CONTRACTOR shall coordinate and install all temporary services in accordance with the requirements of the utility companies having jurisdiction and as required by applicable codes and regulations.

C. All costs in connection with the temporary services including, but not limited to, installation, utility company service charges, maintenance, relocation and removal shall be borne by the Contractor at no additional cost to the County.

1.02 POWER AND LIGHTING

A. Power: CONTRACTOR shall provide, at CONTRACTOR's expense, all necessary power required for CONTRACTOR's operations under the Contract and shall provide and maintain all temporary power lines required to perform the WORK in a safe and satisfactory manner.

B. Source: Power shall be obtained through temporary power meter(s) from the local power company and CONTRACTOR shall pay all connection fees, service fees, taxes, and consumption costs based on monthly meter readings by the power company.

C. Construction Lighting: All WORK conducted at night or under conditions of insufficient day light shall be suitably lighted to ensure proper WORK and to afford adequate facilities for inspection and safe working conditions.

D. Approval of Electrical Connection: All temporary connections for electricity shall be subject to approval by COUNTY and the power company representative and shall be removed in like manner at CONTRACTOR's expense prior to final acceptance of the WORK.

E. Separation of Circuits: Unless otherwise permitted by the ENGINEER, separate lighting circuits from power circuits.

F. Construction Wiring: All wiring for temporary electric light and power shall be properly installed and maintained and securely fastened in place. All electrical facilities shall conform to the requirements of Subpart K of the OSHA Standards for Construction.

1.03 WATER SUPPLY

A. General: CONTRACTOR shall provide, at CONTRACTOR's own expense, an adequate supply of water of a quality suitable for construction purposes.

B. Potable Water: All drinking water on the site during construction shall be furnished by CONTRACTOR and shall be potable water furnished in approved dispensers. Notices shall be posted conspicuously throughout the site warning CONTRACTOR's personnel that other water may be contaminated. For continuous potable water use, potable water may be obtained through connection to an existing potable water line. However, the Contractor shall install a temporary water meter obtained from the County. CONTRACTOR shall pay all connection fees, service fees, taxes, and consumption costs. Consumption costs shall be based on monthly readings of the water meter. Charges shall be paid directly to LCU on the water account established by the Contractor.

C. Water Connections: CONTRACTOR shall not make connection to or draw water from any fire hydrant or pipeline without first obtaining permission of Lee County Utilities. For each such connection made, CONTRACTOR shall first attach to the fire hydrant or pipeline a valve, backflow preventer, and a meter as obtained from Lee County Utilities to set up a new water supply account.

1.04 SANITATION

A. Toilet Facilities: Fixed or portable chemical toilets shall be provided wherever needed for the use of employees. Use of County facilities for general construction personnel is not allowed. Portable toilets which do not have hand washing facilities located within the unit shall have an operable hand sanitizer dispenser containing sanitation liquid affixed to the inside of the unit or immediately adjacent to the unit. Toilets at construction job sites shall conform to the requirements of Subpart D, Section 1926.51 of the OSHA Regulations for Construction. Each contractor shall rigorously prohibit the committing of nuisances within, on, or about the work. CONTRACTOR shall pay all associated installation, removal, and periodic cleanout fees for portable units installed.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01520 - FIELD OFFICE, EQUIPMENT AND SERVICES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall provide an air-conditioned field office with equipment and services for the Contractor's use and the use of the Engineer as specified herein

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01510 – Temporary Utilities

1.03 SUBMITTALS

A. The Contractor shall submit shop drawings and other information as required to the Engineer for review in accordance with Section 01300 entitled "Submittals".

1.04 GENERAL FIELD OFFICE REQUIREMENTS

A. Contractor shall provide steps and platforms to permit entry to the offices. This work shall conform to the Florida Building Code and OSHA requirements.

B. Trailers shall be blocked up and hurricane straps installed conforming to the applicable building codes.

C. Contractor retains responsibility for procuring all necessary permits for the installation of the field offices at the location noted.

D. Air-conditioning shall be available throughout the trailer to maintain internal temperatures to at least 75^{o}F throughout the working day.

PART 2 -- PRODUCTS

2.01 CONTRACTOR'S FIELD OFFICE

A. Contractor's Field Office: Contractor shall furnish, equip and maintain a field office at the site. Field office shall be of a size required for the joint use of the Engineer and Contractor. Contractor shall provide one (1) private office (minimum 12' x 12') for the exclusive use of the Engineer and/or Owner Inspector. Engineer/Owner Inspector's office shall be, at a minimum, provided with the following features at each site:

1. Entry door with cylinder lock, keyed differently from exterior door locks and two (2) sets of keys

2. Two (2) desks with adjustable computer chairs

3. Two (2) two drawer file cabinets

4. Two (2) bookshelves, 36” wide by 48” high.

5. Access to printer/copier with maintenance agreement for the duration of the contract. Printer/copier shall be equipped with 11-inch x 17-inch and 8 ½-inch by 11-inch paper trays. Printer/copier shall be capable of scanning, copying, enlarging, reducing, and printing in color and in black and white.

B. Equipment furnished shall be new or like new in appearance and function.

C. Contractor shall have readily accessible at the field office the following documents: copies of the Contract Documents, addenda, latest approved Shop Drawings, all field project related correspondence, change orders, etc.

D. Field offices shall be provided with a central meeting room for the joint use of the Contractor and the Engineer and/or Owner Inspector. The central meeting room shall be furnished with the following:

1. One conference room table with seating and chairs for eight people.

2. Two paper towel dispensers with paper towels

3. One rack for handling drawings

4. One electric water cooler with bottle water supply and disposable drink cups

5. One first aid cabinet conforming to OSHA requirements for an office up to 15 persons

6. One four cubic ft capacity refrigerator with ice making section

7. One dry erase board (24-inch by 36-inch)

PART 3 -- EXECUTION

3.01 ENGINEER/OWNER INSPECTOR’S OFFICE

A. Make available for Engineer’s use prior to start of Work at site, to remain on site for a minimum of 30 days after final acceptance of the Work.

B. Exterior door keys and interior office keys: Furnish two (2) sets of keys.

C. Telephone:

1. Arrange and provide onsite telephone service for Engineer/Owner Inspector’s use during construction. Pay costs of installation and monthly bills.

2. Provide two incoming lines.

3. Provide high speed DSL line and service.

4. Provide appropriate jacks; locate as directed by Engineer.

5. Provide all necessary wiring for a complete and operable telephone system.

6. Provide one telephone for each desk. Telephones shall be equipped with conference speaker.

D. Maintain in good repair and appearance. Provide weekly cleaning service and replenishment as required, of paper towels, paper cups, hand soap, toilet paper, first aid kit supplies and bottled water.

E. Replenish, as needed, facsimile paper, and copier paper and toner.

3.02 UTILITY SERVICES

A. Potable water will be made available for connection by the Contractor as indicated on the Drawings, who shall pay all costs for water for the Contractor's field office over the duration of the project. The Contractor shall furnish, install, test, and have inspected all piping, valves, and flow meter for connection with the Owner's potable water services.

B. Power: The Contractor shall provide all necessary power required for its operations under the Contract, and shall provide and maintain all temporary power lines required to perform Work in a safe and satisfactory manner. The Contractor shall pay all costs for installation, maintenance and removal for the work and power.

C. Sanitary Services: The Contractor shall provide one totally enclosed water closet and lavatory. The Contractor shall furnish all piping, power and equipment required to convey sanitary waste and discharge into the Plant's sanitary system.

D. High Speed Internet Services: Contractor shall provide high speed internet service for his own use and for that of the Engineer.

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SECTION 01530

PROTECTION OF EXISTING FACILITIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. CONTRACTOR shall protect all existing utilities and improvements not designated for removal and restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than they were prior to such damage or temporary relocation, all in accordance with requirements specified herein, and in accordance with the requirements of the Contract Documents.

B. CONTRACTOR shall determine the exact locations and depths of all utilities indicated on the drawings which affect the WORK. In addition to those indicated, CONTRACTOR shall make exploratory excavations of all utilities. All such exploratory excavations shall be performed as soon as practicable after award of Contract and, in any event, a sufficient time in advance of construction to avoid possible delays to CONTRACTOR's WORK.

C. The number of exploratory excavations required shall be that number which is sufficient to determine the alignment and depth of the utility.

D. Contractor shall be responsible for the preservation and protection of property adjacent to the work site against damage or injury as a result of his operations under this Contract. Any damage or injury occurring on account of any act, omission or neglect on the part of the Contractor shall be restored in a proper and satisfactory manner or replaced by and at the expense of the Contractor to an equal or superior condition than previously existed.

E. Contractor shall comply promptly with such safety regulations as may be prescribed by the County or the local authorities having jurisdiction and shall, when so directed, properly correct any unsafe conditions created by, or unsafe practices on the part of, his employees. In the event of the Contractor's failure to comply, the County may take the necessary measures to correct the conditions or practices complained of, and all costs thereof will be deducted from any monies due the Contractor. Failure of the Engineer to direct the correction of unsafe conditions or practices shall not relieve the Contractor of his responsibility hereunder.

F. In the event of any claims for damage or alleged damage to property as a result of work under this Contract, the Contractor shall be responsible for all costs in connection with the settlement of or defense against such claims. Prior to commencement of work in the vicinity of property adjacent to the work site, the Contractor, at his own expense, shall take such surveys as may be necessary to establish the existing condition of the property. Before final payment can be made, the Contractor shall furnish satisfactory evidence that all claims for damage have been legally settled or sufficient funds to cover such claims have been placed in escrow, or that an adequate bond to cover such claims has been obtained.

1.02 PROTECTION OF WORK AND MATERIAL

A. During the progress of the work and up to the date of final payment, the Contractor shall be solely responsible for the care and protection of all work and materials covered by the Contract.

B. All work and materials shall be protected against damage, injury or loss from any cause whatsoever, and the Contractor shall make good any such damage or loss at his own expense. Protection measures shall be subject to the approval of the Engineer.

1.03 BARRICADES, WARNING SIGNS AND LIGHTS

A. The General Contractor shall provide, erect and maintain as necessary, strong and suitable barricades, danger signs and warning lights along all roads accessible to the public, as required by the authority having jurisdiction, to insure safety to the public. All barricades and obstructions along public roads shall be illuminated at night and all lights for this purpose shall be kept burning from sunset to sunrise.

1.04 RIGHTS-OF-WAY

A. CONTRACTOR shall not do any WORK that would affect any oil, gas, sewer, or water pipeline; any telephone, telegraph, or electric transmission line; any fence; or any other structure, nor shall CONTRACTOR enter upon the rights-of-way involved until notified by the PROJECT MANAGER that the COUNTY has secured authority therefor from the property owner. After authority has been obtained, CONTRACTOR shall give said owner due notice of CONTRACTOR intention to begin WORK, and shall give said owner convenient access for removing, shoring, supporting, or otherwise protecting such pipeline, transmission line, ditch, fence, or structure and for replacing same.

1.05 INTERFERENCE / PRIVILEGED CONTRACTOR

A. When two or more Contracts are being executed at one time on the same or adjacent land in such manner that WORK on one Contract may interfere with that on another, the COUNTY shall decide which CONTRACTOR shall have priority to perform and in what manner. When the territory of one Contract is the necessary or convenient means of access for the execution of another Contract, such privilege of access or any other reasonable privilege may be granted by the COUNTY to the CONTRACTOR so desiring, to the extent, amount, manner, and times permitted. No such decision as to the method or time of conducting the WORK or the use of territory shall be made the basis of any claim for delay or damage, except as provided for temporary suspension of the WORK in Article 16 of the General Conditions of the Contract.

1.06 PROTECTION OF SURVEY MARKERS

A. No pavement breaking or excavation shall be started until all survey or other permanent marker points that will be disturbed by the construction operations have been properly referenced for easy and accurate restoration. It shall be CONTRACTOR's responsibility to notify the proper representatives of the COUNTY of the time and location that WORK

will be done and the identification of all markers involved. Such notification shall be sufficiently in advance of construction that there will be no delay due to waiting for survey points to be satisfactorily referenced for restoration. All survey markers or points disturbed, without proper authorization by the PROJECT MANAGER, will be accurately restored by the COUNTY at CONTRACTOR's expense after all street or roadway resurfacing has been completed.

1.07 UTILITY INVESTIGATION

A. The term existing utilities shall be deemed to refer to both publicly-owned and privately-owned utilities such as electric power and lighting, telephone, water, gas, storm drains, process lines, sanitary sewers and all appurtenant structures.

B. Where existing utilities and structures are indicated on the Drawings, it shall be understood that all of the existing utilities and structures affecting the work may not be shown and that the locations of those shown are approximate only. It shall be the responsibility of the Contractor to ascertain the actual extent and exact location of existing utilities and structures. In every instance, the Contractor shall notify the proper authority having jurisdiction and obtain all necessary directions and approvals before performing any work in the vicinity of existing utilities.

C. Prior to commencing with excavations required for the performance of the WORK, CONTRACTOR shall conduct a field investigation for the purpose of determining existing locations of all underground utilities and facilities which are shown on the drawings. The ENGINEER shall furnish one set of full size drawings for CONTRACTOR's field use in recording the findings of the investigation and for CONTRACTOR's office use in transcribing the field investigation information onto same for submission to the RPR. The investigation shall be made by hand or machine excavation. All such excavations shall include removal of surface material and obstructions required to perform the excavations. CONTRACTOR shall provide sheeting, shoring, and bracing, as required, to minimize the required size of the excavation and support adjacent ground, structures, roadways, and utilities. After the data is obtained at each excavation site, CONTRACTOR shall immediately backfill each excavation site. Backfill shall be compacted sand for the full depth. The surface shall be returned to its original grade and condition except that paved areas may be temporarily surfaced and maintained where excavations required for the performance of the WORK coincide with the location of the investigative location. CONTRACTOR shall be responsible for all costs associated with repair of roadways, paving, structures, underground and above ground utilities and facilities damaged in conducting the investigations.

D. CONTRACTOR shall clearly designate all found utilities and facilities discovered whether or not shown on the contract drawings. CONTRACTOR shall provide written detailed description of any underground utility or facility conflicting with the elevation or alignment of the WORK.

E. CONTRACTOR shall describe size, material, and location of existing underground utilities and facilities. Locations and elevations shall be referenced to project stationing, distance from base line, and project bench marks.

F. Findings of the investigation shall be reported to the RPR.

1.08 EXISTING UTILITIES AND IMPROVEMENTS

A. Prior to any excavation, CONTRACTOR shall notify the authorities representing the COUNTY or agencies responsible for such facilities not less than three working days nor more than five working days prior to excavation so that a representative of said COUNTY or agencies can be present during such WORK if they so desire.

1. In excavation, backfilling, and laying pipe, care shall be taken not to remove, disturb, or injure existing pipes, conduits, structures, or power, telephone and traffic signal poles, etc. If necessary, CONTRACTOR at his own expense shall sling, shore-up, and maintain such structures in operation.

2. In the event items are broken or damaged in the execution of the WORK, CONTRACTOR shall immediately notify the RPR and the proper authorities and, at the option of said authorities, either repair the damage at once at his own expense or pay the proper charges for repairing said damage. Repairs shall be made to the satisfaction of the ENGINEER. CONTRACTOR shall be responsible for any damage to persons or property caused by such breaks or due to his own neglect in reporting and/or repairing such damages.

3. COUNTY or ENGINEER will not be liable for any claims made by the CONTRACTOR based on obstructions that could have been reasonably identified as being different than that indicated on the plans. CONTRACTOR shall uncover subsurface obstructions and identify above ground obstructions sufficiently in advance of construction so that the method of avoiding same may be determined before the WORK reaches the obstruction.

B. The work shall be carried out in a manner to prevent disruption of existing services and to avoid damage to the existing utilities. Temporary connections shall be provided, as required, to insure uninterruption of existing services. Any damage resulting from the work of this Contract shall be promptly repaired by the Contractor at his own expense in a manner approved by the Engineer and further subject to the requirements of any authority having jurisdiction. Where it is required by the authority having jurisdiction that they perform their own repairs or have them done by others, the Contractor shall be responsible for all costs thereof.

C. Where excavations by the Contractor require any utility lines or appurtenant structures to be temporarily supported and otherwise protected during the construction work, such

support and protection shall be provided by the Contractor. All such work shall be performed in a manner satisfactory to the Engineer and the respective authority having jurisdiction over such work. In the event the Contractor fails to provide proper support or protection to any existing utility, the Engineer may, at his discretion, have the respective authority provide such support or protection as may be necessary to insure the safety of such utility, and the costs of such measures shall be paid by the Contractor.

D. Utilities To Be Moved: In case it shall be necessary for others to move the property of any public utility or franchise holder, such utility company or franchise holder will, upon proper application by the CONTRACTOR, be notified by the PROJECT MANAGER to move such property within a specified reasonable time. CONTRACTOR shall not interfere with said property until after the expiration of the time stipulated.

E. COUNTY's Right Of Access: The right is reserved to the COUNTY and to the owners of public utilities and franchises to enter at any time upon any public street, alley, right-of-way, or easement for the purpose of making changes in their property made necessary by the WORK of this Contract.

F. Known Utilities: Existing utility lines that are shown on the drawings or the locations of which are made known to the CONTRACTOR prior to excavation that are to be retained and all utility lines that are constructed during excavation operations shall be protected from damage during excavation and backfilling and, if damaged, shall be immediately repaired by CONTRACTOR at CONTRACTOR's expense.

G. Unknown Utilities: If CONTRACTOR damages any existing utility lines that are not shown on the drawings or the locations of which are not made known to CONTRACTOR prior to excavation, or were, or could not have been verified or located by the CONTRACTOR prior to starting WORK in accordance with the General Conditions, a written report thereof shall be made immediately to the PROJECT MANAGER.

H. Utilities To Be Removed: When utility lines that are to be removed are encountered within the area of operations, CONTRACTOR shall notify the PROJECT MANAGER a sufficient time in advance for the necessary measures to be taken to prevent interruptions of the service.

I. Approval Of Repairs: All repairs to a damaged improvement shall be inspected and approved by an authorized representative of the improvement before being concealed by backfill or other work.

J. Relocation Of Utilities: Where the proper completion of the WORK requires the temporary or permanent removal and/or relocation of an existing utility or other improvement which is shown on the drawings, CONTRACTOR shall at CONTRACTOR's own expense, remove and, without unnecessary delay, temporarily replace or relocate such utility or improvement in a manner satisfactory to the PROJECT MANAGER and the COUNTY of the facility. In all cases of such temporary removal or relocation, restoration to former location shall be accomplished by CONTRACTOR in a manner that will restore or replace the utility or improvement as nearly as possible to its former locations and to as good or better condition than found prior to removal.

K. Maintaining In Service: All oil and gasoline pipelines, power, telephone, or other communication cable ducts, gas and water mains, irrigation lines, sewer lines, storm drain lines, poles, and overhead power and communication wires and cables encountered along the line of the WORK shall be maintained continuously in service during all the operations under the Contract, unless other arrangements satisfactory to the PROJECT MANAGER are made with the OWNER of said pipelines, duct, main, irrigation line, sewer, storm drain, pole, wire, or cable. CONTRACTOR shall be responsible for and shall make good all damage due to CONTRACTOR's operations, and the provisions of this Section shall not be abated even in the event such damage occurs after backfilling or is not discovered until after completion of the backfilling.

1.09 TREES WITHIN STREET RIGHTS-OF-WAY AND PROJECT LIMITS

A. General: CONTRACTOR shall exercise all necessary precautions so as not to damage or destroy any trees or shrubs, including those lying within street rights-of-way and project limits, and shall not trim or remove any trees unless such trees have been approved for trimming or removal by the PROJECT MANAGER. All existing trees and shrubs which are damaged during construction shall be trimmed or replaced by CONTRACTOR or a certified tree company under permit from the jurisdictional agency or COUNTY and to the satisfaction of said agency and/or the COUNTY. Tree trimming and replacement shall be accomplished in accordance with the following paragraphs.

B. Trimming: Symmetry of the tree shall be preserved, and no stubs or splits or torn branches left. Clean cuts shall be made close to the trunk or large branch. Spikes shall not be used for climbing live trees. All cuts over one and a half inch in diameter shall be coated with an asphaltic emulsion material.

C. Replacement: CONTRACTOR shall immediately notify the jurisdictional agency and/or the COUNTY if any tree not approved for removal by the PROJECT MANAGER is damaged by CONTRACTOR's operations. If, in the opinion of said agency or the OWNER, the damage is such that replacement is necessary, CONTRACTOR shall replace the tree at CONTRACTOR's own expense. The tree shall be of a like size and variety as the tree damaged or, if of a smaller size, CONTRACTOR shall pay OWNER of said tree a compensatory payment acceptable to OWNER, subject to the approval of the PROJECT MANAGER.

D. CONTRACTOR shall take the following specific measures to protect existing trees that are not to be completely removed as part of the WORK.

1. Construct short tunnels beneath trees or other surface structures, where possible. Support trees or structures and protect from damage.

2. Barricade trees within 25 feet of centerline of proposed pipeline. Construct barricades as shown on the plans.

3. Prune roots, 3 inches in diameter and larger, clean with no shredded ends. Backfill roots as soon as possible.

4. Prune lower branches of trees that may interfere with machinery to avoid broken and damaged limbs.

5. Use the smallest machine that will accomplish the WORK when installing piping near or beneath trees.

1.10 EXISTING FENCELINES

A. At various locations along the length of the project, existing fences might conflict with or impair construction operations for the installation of the new pipeline. CONTRACTOR shall protect these fences in place where they do not conflict with construction operations. Where a fence may conflict with the backswing of machinery or otherwise impede construction, CONTRACTOR shall contact the Owner and arrange for the temporary removal or relocation of the fence. Any fence removed or temporarily relocated shall be restored to its original condition and location unless otherwise arranged with the Owner's of the fence. Where it is impossible to salvage the existing materials to reconstruct the fence, the fence shall be replaced "in kind".

B. Where existing walls and fences are necessary to be removed in order to construct the WORK per plan then the CONTRACTOR shall remove and dispose of the existing fence or wall and construct a new fence or wall in the new location indicated. The new fence or wall shall be of the same material and style as the section of fence or wall removed. Fences or walls shall be painted as required to match the original color of the fence or wall removed. CONTRACTOR shall notify property owner, and PROJECT MANAGER a minimum of seven days before removing fences or walls.

C. All cost for such temporary removal, replacement, or "in kind" replacement shall be included as indicated in the unit prices bid. No direct payment will be made for fence replacement unless specifically noted otherwise.

1.11 SPECIAL RESTORATION REQUIREMENT

A. The CONTRACTOR shall schedule and conduct operations to minimize the impact of construction upon grassed areas, roadways, sidewalks, irrigation systems, and other site improvements. Restoration for these items shall be completed as soon as practical after installation of proposed pipelines.

1. Irrigation Systems: Provide ten day written notification to property owners to allow time for removal of irrigation system components.

2. Stone Areas: A majority of the site is covered in stone in lieu of a grass covering. Contractor shall take precautions to preserve, and not to crush, existing stone cover.

For excavation areas or areas requiring the use of heavy equipment, Contractor shall remove the stone covering and stock pile the material for later use in restoring the stoned areas to original or better condition.

3. Lawn Areas: The CONTRACTOR shall avoid all grass areas. If such areas are inadvertently damaged by construction activity, sod shall be placed in a strip of uniform width along each section of disturbed lawn area with sod of identical type as existing and at the same depth.

4. Trees, Shrubs and Landscaping: Damage to existing trees, shrubs, and landscaping by construction activity shall be avoided and the CONTRACTOR shall take every precaution to avoid damage to existing site landscape improvements.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 01540

MAINTENANCE OF UTILITY OPERATIONS DURING CONSTRUCTION

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The existing plant must be maintained in continuous operation during the entire construction period of the Contract as hereinafter specified. The intent of this Section is to outline the minimum requirements necessary to provide continuous treatment and meeting of all facility permit requirements throughout the construction period.

B. Work under the Contract shall be scheduled and conducted by the Contractor so as not to impede any treatment process, reduce the quality of the plant effluent, interfere with the plant's ability to meet permit requirements, or cause odor or other nuisances to the plant operations and maintenance staff. In performing the work shown and specified, the Contractor shall plan and schedule the work to meet the plant operating requirements in accordance with the constraints and construction requirements as outlined in this Section. No discharge of raw or treated wastewater shall be allowed. The Contractor shall pay all civil penalties, costs, assessments, etc., associated with any discharge of raw or treated wastewater resulting from the Contractor's work.

C. The Contractor shall be responsible for coordinating the general construction and the schedules of all subcontractors and for ensuring that permanent or temporary power and controls are available for all existing, proposed, and temporary facilities that are required at any given time.

D. The Contractor has the option of providing additional temporary facilities that can eliminate a constraint, provided it is done without additional cost to the County and provided that all requirements of these Specifications are fulfilled. Work not specifically covered in the following paragraphs may, in general, be done at any time during the contract period, subject to the operating requirements and constraints and construction requirements outlined hereinafter. All references to days in this Section are in consecutive calendar days.

1.02 GENERAL CONSTRAINTS

A. The Contractor shall schedule the Work so that the plant is maintained in continuous operation. All treatment processes shall be maintained in continuous operation during the construction period except during approved process interruptions. All short-term system or partial system shutdowns and/or diversions shall be approved by the ENGINEER with concurrence from County operations staff. Long-term process shutdowns and diversions shall conform to the requirements hereinafter specified and shall be minimized by the Contractor as much as possible. If in the judgment of the County a requested shutdown is not required for the Contractor to perform the Work, the Contractor shall utilize approved alternative methods to accomplish the Work. All

shutdowns shall be coordinated with the County and scheduled at times suitable to the County. Shutdowns shall not begin until all required materials are on hand and ready for installation. Each shutdown period, with no temporary services in place, shall commence at a time approved by the County, and the Contractor shall proceed with the Work continuously, (24 hours/day, 7 days/week) start to finish, until the Work is completed and normal plant operation is restored. If the Contractor completes all required Work before the specified shutdown period has ended, the County may immediately place the existing system back into service once accepted.

B. Short-term shutdowns in ability to operate equipment will be allowed for tie-ins to existing piping or for disconnection and/or reconnection of equipment power feeds. All such shutdowns shall be scheduled at times approved by the County and shall be for durations as agreed to with the County but no more than four (4) hours. The schedule and duration of short-term shutdowns shall be at the discretion of the County.

C. The Contractor shall schedule shutdowns in advance and shall present all desired shutdowns in the 30 and 60-day schedules at the progress meetings. Shutdowns shall be fully coordinated with the Plant Superintendent at least 72 hours before the scheduled shutdown. County personnel shall operate County's facilities involved in the shutdowns.

D. Any temporary work, access ramps, equipment, path ways, protection of existing structures, piping, blind flanges, valves, equipment, etc. that may be required within the Contractor's work limits to maintain continuous and dependable plant operation shall be furnished by the Contractor at the direction of the Engineer at no additional cost to the County.

E. The County shall have the authority to order work postponed, stopped or prohibited that would, in their opinion, unreasonably result in interrupting the necessary functions of the plant operations.

F. If the Contractor impairs performance or operation of the plant as a result of not complying with specified provisions for maintaining plant operations, then the Contractor shall immediately make all repairs or replacements and do all work necessary to restore the plant to operation to the satisfaction of the County. Such work shall progress continuously to completion on a 24-hours per day, seven work days per week basis at the Contractor’s expense.

1.03 GENERAL OPERATING REQUIREMENTS, CONSTRAINTS, AND REQUIREMENTS

A. Access to Plant Site, Roadways, and Parking Areas

1. An unobstructed traffic route through the Main Gate shall be maintained at all times for the County's operations personnel and maintenance equipment. Parking for personal vehicles of construction personnel shall only be allowed on-site within designated Contractor staging areas identified on the Drawings. Construction personnel may park on County or public property outside the plant

fence in areas approved by the County. The Contractor shall be responsible for providing access to and for preparing and maintaining/approved parking areas.

2. An unobstructed traffic route around the plant site shall be maintained at all times for the County's operations personnel and maintenance equipment. Vehicular access to the treatment units and buildings for County personnel shall be maintained at all times by the Contractor.

3. The Contractor shall provide temporary measures to protect the existing pavement by filling over with earthen material or supplying other measures acceptable to the Engineer, and shall repair any damage to existing paved surfaces that occurs during the construction period. Any areas disturbed along the shoulders of the access road and interior roads and elsewhere inside and outside of the plant shall be repaired, seeded, etc. as necessary to match pre-existing conditions at no additional cost to the County.

4. The Contractor shall not undertake the final restoration of new or existing roadway (paved, gravel, or asphalt overlay) damaged by construction activities, until all other work on the plant improvements has been completed.

B. Personnel Access: Treatment plant personnel shall have access to all areas of the facility throughout the construction period. The Contractor shall locate stored material, dispose of construction debris and trash, provide temporary walkways, provide temporary lighting, and other such work as directed by the Engineer to maintain personnel access to areas in operation. Access and adequate parking areas for plant personnel shall be maintained throughout construction.

C. Plumbing Facilities: Sanitary facilities in the existing structures shall be operational at all times and shall be for plant operating personnel exclusively. Temporary sanitary facilities for the Contractor’s use shall be supplied by the Contractor and shall be either connected to waste collection facilities approved by the County or periodically pumped out by the Contractor at appropriate intervals.

D. Building Air Conditioning and Ventilating: Building air conditioning and ventilating for the existing plant structures shall be in service for the entire construction period. For air conditioning and ventilation systems being replaced under this contract, the existing system shall remain in service until the replacement system is ready to be installed and temporary air conditioning and ventilation shall be provided as required to adequately cool and vent facilities under construction and/or while systems are being replaced.

E. Power, Light and Communications Systems (General): Electric power, lighting service and communications systems shall be maintained in uninterrupted operation in all areas of the facility. Individual units may be disconnected as required for replacement, but service shall be available at all times including periods when plant elements are out of service. The Contractor and electrical subcontractor shall coordinate shutdowns required to minimize the total number of shutdowns needed to complete construction. County's phone service to the plant shall be maintained in continuous operation during construction. Temporary excavations, blocking of normal access routes, and areas of

active construction shall be well marked and cordoned off for safety of plant personnel and well lit at night using temporary lighting. CONTRACTOR shall pay all necessary costs related to continuously maintain the plant's power, lighting, and communications systems which may be impacted by the Work either as needed to complete the Work or for repairs resulting from accidental interruption.

F. Draining Process Pipes and Conduits (General): The contents of all pipes and conduits to be removed, replaced or relocated (or dewatered for a specific purpose) shall be transferred to a suitable facility in a manner approved by the County through hoses or piping, or by using pumps if hydraulic conditions so require them. The Contractor shall provide the pumps, piping and hoses at no additional cost to the County. No uncontrolled spillage of a pipe or conduit shall be permitted. Any spillage, other than potable water, shall be immediately washed down and flushed into an appropriate collection area. CONTRACTOR shall be responsible for making required notifications to applicable regulatory agency and pay all fees associated with such spills caused by construction activities.

G. Potable Water System: Potable water service shall be maintained in continuous service at all times during construction except for short term interruptions required for tie-ins. Shutdown of the potable water system shall be fully planned and coordinated with the County and shall be limited to not more than two (2) hours. Existing fire hydrants on potable water lines within the plant site shall be operational at all times, unless otherwise approved by the County.

H. Non-potable Water System: The existing non-potable water (reuse water) service shall be maintained in continuous operation during construction except for short term tie-ins of new or temporary facilities to existing facilities, until the new or re-routed non-potable water lines are brought into service. Temporary non-potable service for seal water systems shall be provided by the Contractor as necessary to insure continuous, uninterrupted service of these critical systems.

I. Sump Pumps and Sumps: All existing sumps shall be maintained in an operable condition with either existing pumps or temporary pumps. Interim piping, power and controls shall be provided as required by the staged construction sequence.

J. Stormwater Ponds and Drainage: All existing drainage inlets, swales, and drainage culverts shall remain in service throughout the construction period such that no flooding of the existing facilities or grounds occurs.

1.04 CONSTRUCTION SEQUENCE AND OPERATIONAL CONSTRAINTS

A. Work under the Contract shall be scheduled and performed in such a manner as to result in the least possible disruption to the operation of the existing treatment facilities. Process control modifications shall not be made without first obtaining written permission from the Engineer. Areas of the work may require the Contractor to dewatering wastewater lines. The Contractor shall be responsible for the proper containment and disposal of wastewater drained from pipelines during construction.

The Contractor shall contain such wastewater (in accordance with all applicable codes) and shall dispose of such to an on-site wastewater basin as directed by the County.

B. The sequence of construction shall be such as to minimize interferences and disruptions to the wastewater reclamation facility, roads, home owners, other utilities, and to the normal operation of other agencies having jurisdiction over the project.

C. At no time shall the Contractor undertake to close off any pipelines, or open valves, or take any other action that would affect the operation of the existing system, except as specifically required by the Contract Documents, after authorization is granted by the County or Engineer and after proper notification.

D. At no time shall the Contractor interrupt traffic, close streets or redirect traffic without previous authorization from the agencies having jurisdiction over the project.

E. The County may require the Contractor to finish certain portions of work that is in progress before work is started on any additional portion. The County may also require the Contractor to wait for completion of work being performed by other Contractors.

F. Critical events in the sequence of construction are specified herein. The outline sequence of construction does not include all items necessary to complete the work but is intended to identify the sequence of critical events necessary to minimize disruption to the on-going treatment plant process and to ensure compliance with discharge requirements. It shall be understood by the Contractor that the critical events identified are not all inclusive and that additional items of work not shown may be required. The sequence of construction is a precedence requirement and does not attempt to schedule the Contractor's work. It is intended only to indicate which activities must precede other activities in order to minimize interferences and disruptions. The construction sequence described herein includes recommended phasing of the work. If an alternate phasing is proposed by the Contractor, the Contractor shall gain full approval of the Engineer before proceeding.

1. Stage 1 – Mobilization, Preliminary Site, and Sodium Hypochlorite Installation

    a. Mobilize for work - set up staging area, obtain permits, develop and submit construction schedule, shop drawing schedule and begin shop drawing submittals.

    b. Submit shop drawings and obtain approval for equipment and materials.

    c. Install temporary erosion control measures as identified in the contract documents and stake out site to verify structure and equipment locations, pipe routing, and locations of tie-ins. Perform soft digs and site assessment to verify location and depth of existing piping for tie-ins and pipe crossings.

    d. Construct new concrete pad and metal structure for the new sodium hypochlorite storage and feed facility and future sodium bisulfite system.

Install new sodium hypochlorite storage tanks and feed skid. Coordinate installation of the tanks with installation of the metal structure.

e. Install sodium hypochlorite feed piping to near point of connection including all yard piping and hand hole installations needed.

f. Remove pavement and install new storm water line from pond to near new dewatering structure (to be able to relocate the mobile dewatering system under Stage 2). Pressure test line. Cover ends of lines.

g. Install permanent power and fiber optic communications conduits with pull chords under the existing roadway up to near the area of the new dewatering structure (to be able to relocate the mobile dewatering system under Stage 2). Cover ends of conduit lines. Stabilize roadway.

h. Install new Hypochlorite PLC panel and install temporary power to the panel and hypochlorite facility from nearest existing lighting panel (temporary power conduit and wire can be run exposed). Install temporary fiber optic conduit and cable from the new PLC panel to the existing LS PLC panel for connection and communication with the plant network.

i. Complete plant HMI programming to allow operator interface with the new hypochlorite PLC system for full remote control of the new process as well as needed interface with plant flow for automatic dosing of the feed process. Existing hypochlorite feed system to remain in service during preliminary testing of the new process.

j. Perform preliminary functional tests on new sodium hypochlorite storage and feed system equipment and controls to verify operational readiness.

k. Schedule a shutdown of the disinfection system with the County of less than 2 hours at an approved low flow period. Re-use existing sodium hypochlorite flow meter and flow signal (over existing network communications) and tie new feed line into existing injection point piping.

l. Perform start-up and operational testing on new sodium hypochlorite storage and feed system.

m. Obtain acceptance of new sodium hypochlorite storage and feed system and place into operation. Begin Stage 2 (Stage 1 must be complete before removing existing hypochlorite storage and feed equipment).

2. Stage 2 – Dewatering Area Demolition, Mobile Dewatering Unit Relocation, Existing Pipe Relocations, Lift Station Pump Replacement, and Existing Sludge Piping Modifications.

a. Perform demolition of the existing sodium hypochlorite storage tanks, feed skids, and appurtenances.

b. Install temporary digested sludge feed, centrate drain, plant water, and electrical services for the relocation of the mobile dewatering unit.

c. Schedule a shutdown of the dewatering operation. Relocate the existing trailer mounted mobile dewatering unit to its temporary location, connect to temporary digested sludge feed, centrate drain, plant water, and power lines, and perform process testing to verify operation. This work is to be completed within 1 day. Contractor is to submit proposed location and type of temporary connections for the sludge feed, centrate drain, plant water supply, power supply, and SCADA interconnect for approval at least 3 weeks ahead of the need for these connections to be in service. Suggested connection points are as follows:

   1) Sludge feed: Existing pump out SE of lift station.

   2) Centrate drain: Vent at lift station.

   3) Plant water: hydropneumatics tank south of lift station.

   4) Power supply: as suggested on E-4

   5) SCADA interconnect: lift station control panel

d. Demolish existing dewatering structure, foundations, and pavement. Maintain digested sludge, plant water, centrate drain, and power connections for relocated mobile dewatering unit.

e. Install new buried 4” reclaimed water relocation and new service lines to near points of connection and up to isolation valves at the plant water booster pump, polymer make up units, and at the new sludge feed pump flush points. Install new buried 6” backwash water relocation lines to near points of re-connection. Pressure test new piping.

   1) Schedule a shutdown of the plant reclaimed water lines near the dewatering structure as well as the filter backwash process.

   2) Make tie-ins for relocated and new services for reclaimed water and for relocated backwash water to place lines back in service.

   3) Tie-ins to be completed within 4 hours (which may require more than one tie-in event).

f. Install new submersible pumps and appurtenances at the existing lift station as follows:

   1) Schedule a shutdown of the trailer mounted mobile dewatering unit and ensure no process drains are open to the lift station.

   2) Shut down lift station, remove existing pumps and install new pumps, wetwell discharge piping, and appurtenances, and make modifications to the existing control panel (new starters).

3) Perform start up and field testing to place lift station back in service.

4) Limit shutdown to up to 3 consecutive week days during which the County will refrain from dewatering activities. However, the Contractor is to make arrangements to have a temporary submersible pump available to be delivered and placed in operation within 24 hours for emergency pump out to the filter mud well if needed.

g. Install new 6-inch digested sludge piping as shown on the drawings from isolation valves on the suction side of the new sludge feed pumps to near points of connection at two locations on the existing digested sludge lines. Pressure test new piping.

1) Schedule shutdown of relocated trailer mounted mobile dewatering unit.

2) Demolish existing progressive cavity pump and the 6-inch piping as shown and make tie-ins to existing digested sludge piping. Install revised digester discharge piping as shown to keep existing end-suction pump in service for feeding a liquid hall truck if needed and for use in supply to the mobile dewatering unit. Limit shutdown to 4 hours.

3) Visually inspect tie-in locations and place relocated mobile sludge dewatering system back in service.

h. Install new buried process drain lines from lower level floor drain and through lower slab for lines up to upper level as well as new manholes. Do not break open existing line under dog house manhole until associated part of Stage 3 work. Pressure test lines and provide temporary caps on stub ups through slab for drain lines to upper level. Block floor drain inlet to prevent collecting debris in the drain line.

i. Install new buried storm water lines and inlets around new dewatering structure, including capped stub ups to structure rain gutters, and tie into new storm water line to pond installed in Stage 1. Pressure test and place new storm water lines in service with protections around new inlet from construction debris. Coordinate this work with installation of relocated plant water lines, new digested sludge lines, and demolition of existing plant water and digested sludge lines.

j. Install buried electrical conduit and duct banks from existing switchboard room to stub ups at dewatering structure, all buried conduit between dewatering structure and new sludge pump area, and buried conduit between dewatering structure and hypochlorite system conduits installed in Stage 1. Install with pull strings and cap conduits.

3. Stage 3 – Dewatering System Installation

a. Install sludge feed pump slab and buried discharge piping from pump isolation valves to stub in slab at new dewatering structure. Pressure test lines.

b. Construct dewatering structure lower level concrete pad drive through, polymer tote and polymer make up unit concrete pad, embedded trenches and drain line connections to buried drain lines installed in Stage 2, followed by construction of the dewatering structure concrete columns and upper level slab and beams.

c. Install precast concrete electrical building.

d. Install new dewatering canopy and bridge crane. Test and confirm operation of bridge crane.

e. Install sludge feed pumps, grinders, and all above ground digested sludge and flush water piping, fittings, valves, and flow meter.

f. Install polymer tote weigh scales, polymer totes, polymer make up units, neat polymer piping, dilute polymer feed piping, and plant water supply lines.

g. Install dewatered cake conveyor system and catwalk.

h. Install centrifuge platform access walkway and stairs. Connect new overhead walkway to existing walkway.

i. Complete remaining above ground digested sludge piping, plant water piping, centrate drain piping, floor drain piping, vent piping, and dilute polymer feed piping at dewatering structure. Perform pressure testing on pipe.

j. Install centrifuge(s) and appurtenances.

k. Make process piping connections to centrifuge(s).

l. Install all electrical and instrumentation components, conduit, wiring, configuration, permanent connections of hypochlorite and dewatering system fiber optic network communications, and programming of PLC and plant HMI. Remove temporary power and communication lines to hypochlorite system (perform transition from temporary power and communication to permanent system using parallel connections to avoid interruption of hypochlorite feed capability).

m. Perform functional tests on new centrifuge, polymer make-up units, and sludge feed pumps and control systems.

4. Stage 4 – Dewatering System Start Up and Testing

a. Perform start-up, operational, and performance testing on new dewatering system, including centrifuge and appurtenances, polymer make-up units, sludge feed pumps, and control systems.

b. Obtain acceptance of new centrifuge, polymer make-up units, sludge feed pumps and place into operation.

c. Schedule a shut down of the dewatering system to remove the existing end-suction digested sludge pump and appurtenances and install 6-inch piping in its place. Limit shutdown to 4 hours

5. Stage 5 – Close Out and Demobilization

a. Release mobile dewatering unit to County, remove temporary sludge feed, drain, water, and power lines to the unit, and complete final site improvements and paving and site clean-up.

b. Obtain final acceptance of the project.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01550

SITE ACCESS AND STORAGE

PART 1 -- GENERAL

1.01 HIGHWAY LIMITATIONS

A. The Contractor shall make their own investigation of the condition of available public and private roads and of clearances, restrictions, bridge load limits, and other limitations affecting transportation and ingress and egress to the site of the Work. It shall be the Contractor's responsibility to obtain clearances and roadway special provisions required for its construction operations in the delivery of products and delivery and return of rental equipment requiring oversized loads.

1.02 TEMPORARY CROSSINGS

A. Access Road Use: Nothing herein shall be construed to entitle the Contractor to the exclusive use of any on site access road or parking area during the performance of Work hereunder, and Contractor shall conduct operations as not to interfere unnecessarily with the authorized work of other contractors or LCU's staff in these access roads and parking areas. No roadway shall be closed to normal facility operation and delivery vehicles other than the area through the existing dewatering operations. Where excavation is being performed in roadways, one lane shall be kept open to traffic at all times unless otherwise approved.

1.03 CONTRACTOR'S WORK AND STORAGE AREA

A. Storage and staging areas shall be within the site and the Contractor's proposed areas shall be reviewed by the Engineer prior to construction. Responsibility for protection and safekeeping of equipment and materials at or near the site will be solely that of the Contractor and no claim shall be made against the County by reasons of any act of an employee or trespasser. Should an occasion arise necessitating access to an area occupied by stored equipment and/or materials, the Contractor shall immediately move them.

B. If the Contractor requires additional storage/staging area, the Contractor shall obtain such areas from off site sources at no additional cost to the County. The Contractor shall not enter or occupy private land outside of easements, except by permission of the County.

C. If directed by the Engineer, move any stored items which interfere with the operations of the County.

D. Upon completion of the Contract, the Contractor shall remove from the storage areas all of their equipment, temporary fencing, surplus materials, rubbish, etc., and restore the areas as specified.

1.04 SAFETY AND PROTECTION DEVICES

A. The Contractor shall take all necessary precautions for the safety of its employees on the job and shall comply with all applicable provisions of Federal, State, County, and Municipal safety laws and regulations to prevent accidents or injury to persons on, about, or adjacent to the premises where the Work is being performed.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01600

MATERIALS AND EQUIPMENT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The word "Products," as used herein, is defined to include purchased items for incorporation into the Work, regardless of whether specifically purchased for project or taken from Contractor's stock of previously purchased products. The word "Materials," is defined as products which must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, installed, or applied to form units of Work. The word "Equipment" is defined as products with operational parts, regardless of whether motorized or manually operated, and particularly including products with service connections (wiring, piping, and other like items). Definitions in this paragraph are not intended to negate the meaning of other terms used in Contract Documents, including "specialties," "systems," "structure," "finishes," "accessories," "furnishings," special construction," and similar terms, which are self-explanatory and have recognized meanings in the construction industry.

B. Within 15 calendar days of the date of the Notice to Proceed, the Contractor shall submit to the Engineer a list of the names of proposed manufacturers, material, suppliers and subcontractors, obtain approval of this list by the Engineer prior to submission of any working drawings. Upon request, the Contractor shall submit evidence to the Engineer that each proposed manufacturer has manufactured a similar product to the one specified and that it has previously been used for a like purpose for a sufficient length of time to demonstrate its satisfactory performance.

C. All material and equipment designed or used in connection with a potable (drinking) water system shall conform to the requirements of the National Sanitation Foundation (NSF) Standard 61, "Drinking Water System Components - Health Effects."

D. Furnish and install material and equipment which meets the following:

1. Equipment and appurtenances shall be designed in conformity with the ASME, AIEE, NEMA and other generally accepted applicable standards and shall be rugged construction and of sufficient strength to withstand all stresses which may occur during fabrication, testing, transportation, installation and all conditions of operation.

2. Complies with size, make, type, and quality specified or as specifically approved, in writing, by Engineer.

3. Will fit into the space provided with sufficient room for operation and maintenance access and for properly connecting piping, ducts and services, as applicable. Make clear the spaces that will be available for operation and maintenance access and connections equal to or greater than those shown and meeting all the manufacturers' requirements. If adequate space is not available,

the Contractor shall advise the Engineer for resolution.

4. Manufactured and fabricated in accordance with the following:

   a. Design, fabricate, and assemble in accordance with best engineering and shop practices.

   b. Manufacture like parts of duplicate units to standard sizes and gauges, to be interchangeable.

   c. Provide two or more items of same kind identical, by same manufacturer.

   d. Provide materials and equipment suitable for service conditions.

   e. Adhere to equipment capabilities, sizes, and dimensions shown or specified unless variations are specifically approved, in writing, in accordance with the Contract Documents.

   f. Adapt equipment to best economy in power consumption and maintenance. Proportion parts and components for stresses that may occur during continuous or intermittent operation, and for any additional stresses that may occur during fabrication or installation.

   g. Working parts are readily accessible for inspection and repair, easily duplicated and replaced.

5. Use material or equipment only for the purpose for which it is designed or specified.

1.02 QUALITY ASSURANCE

A. Source Limitations: To the greatest extent possible for each unit of Work, the Contractor shall provide products, materials, or equipment of a singular generic kind from a single source.

B. Compatibility of Options: Where more than one choice is available as options for Contractor's selection of a product, material, or equipment, the Contractor shall select an option which is compatible with other products, materials, or equipment already selected. Compatibility is a basic general requirement of product/material selections.

1.03 DESIGN

A. All bearings and moving parts shall be adequately protected by bushings or other acceptable means against wear, and provision shall be made for adequate lubrication by readily accessible devices. Details shall be designed for appearance as well as utility. Protruding members, joints, corners, gear covers, etc., shall be finished in appearance.

B. All exposed welds on machinery shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.

1.04 TRANSPORTATION, DELIVERY AND HANDLING

A. Products shall be transported by methods to avoid product damage and shall be delivered in undamaged condition in supplier's original, unopened containers or packaging with identifying labels intact and legible. The Contractor shall ensure that bright machined surfaces, such as shafts and valve faces, shall be protected with a heavy coat of grease prior to shipment.

B. Delivery schedules shall be controlled in accordance with the Construction Progress Schedules covered in Section 01300 entitled “Submittals” to minimize long-term storage of products at site and overcrowding of construction spaces. In particular, the Contractor shall provide delivery/installation coordination to ensure minimum holding or storage times for products recognized to be flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other sources of loss. Arrange deliveries of materials and equipment. Coordinate to avoid conflict with work and conditions at site.

C. Immediately upon delivery, inspect shipments to determine compliance with requirements of Contract Documents and approved submittals and that material and equipment are protected and undamaged.

D. The Contractor shall provide equipment and personnel to handle products, materials, and equipment including those provided by the County, by methods to prevent soiling and damage.

E. The Contractor shall provide additional protection during handling to prevent marring and otherwise damaging products, packaging, and surrounding surfaces.

F. The Contractor shall transport, deliver, and handle products in accordance with supplier's written recommendations and by means and methods that will prevent damage, deterioration, and loss including theft

1.05 STORAGE AND PROTECTION

A. Products shall be stored in accordance with supplier's written instructions, with seals and labels intact and legible. Sensitive products shall be stored in weather-tight enclosures and temperature and humidity ranges shall be maintained within tolerances required by supplier's written instructions. Contractor shall obtain and distribute printed copies of such instructions to parties involved in installation, including six copies to Engineer. One set of complete instructions shall be maintained at the jobsite during storage and installation, and until completion of work.

B. For exterior storage of fabricated products, they shall be placed on sloped supports, blocking or skids, above ground to prevent soiling or staining. Products subject to deterioration shall be covered with impervious sheet covering; ventilation shall be provided to avoid condensation.

C. Loose granular materials shall be stored on solid surfaces in a well-drained area and shall be prevented from mixing with foreign matter.

D. Storage shall be arranged to provide access for inspection and maintenance. The Contractor shall periodically inspect to assure products are undamaged and are maintained under required conditions.

E. Coordinate location of storage areas with Engineer.

F. Arrange on site storage areas for proper protection and segregation of stored materials and equipment with proper drainage. Provide for safe travel around storage areas and safe access to stored materials and equipment.

G. Store materials such as pipe, reinforcing and structural steel, and equipment on pallets, blocks or racks, off ground.

H. Coordinate installation of work such that stored materials are in on-site storage for no more than 60 days.

1.06 MAINTENANCE OF STORAGE

A. Store, maintain, handle, install, connect, clean, condition, and adjust products in accordance with manufacturer's written instructions and in conformity with Specifications. Should job conditions or specified requirements conflict with manufacturer's instructions, consult Engineer for further instructions.

B. Stored products shall be periodically inspected on a scheduled basis. The Contractor shall maintain a log of inspections and shall make said log available to the Engineer on request. The Contractor shall verify that storage facilities comply with supplier's product storage requirements and that supplier-required environmental conditions are maintained continually.

C. The Contractor shall verify that surfaces of products exposed to the elements are not adversely affected and that any weathering of finishes is acceptable under requirements of Contract Documents.

D. For mechanical and electrical equipment in long-term storage:

1. The Contractor shall provide a copy of the supplier's service instructions to accompany each item, with notice on enclosed instruction shown on exterior of package.

2. Equipment shall be serviced on a regularly scheduled basis, and a log of services shall be maintained and submitted as a record document to the Engineer.

E. The County assumes no responsibility for materials or equipment stored in buildings or on-site. Contractor assumes full responsibility for damage due to storage of materials or equipment.

F. The Contractor assumes full responsibility for protection of completed construction until facilities (or portions of facilities) are accepted for operation and placed in service. Repair and restore damage to completed Work equal to its original condition.

1.07 LUBRICANTS

A. During testing and prior to acceptance, the Contractor shall furnish all lubricants necessary for the proper lubrication of all equipment furnished under this Contract.

1.08 SPECIAL TOOLS

A. For each type of equipment furnished by it, the Contractor shall provide a complete set of all special tools (including calibration and test equipment) which may be necessary for the adjustment, operation, maintenance and disassembly of such equipment.

B. Special tools shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such special tools until completion of the Work, at which time they shall be delivered to the County.

1.09 PROTECTION AGAINST ELECTROLYSIS

A. Where dissimilar metals are used in conjunction with each other, suitable insulation shall be provided between adjoining surfaces so as to eliminate direct contact and any resultant electrolysis. The insulation shall be bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators or washers, or other acceptable materials.

1.10 FASTENERS

A. All necessary bolts, anchor bolts, nuts, washers, plates and bolt sleeves shall be furnished by the Contractor in accordance herewith. Bolts shall have suitable washers and, where so required, their nuts shall be hexagonal.

B. All bolts, anchor bolts, nuts, washers, plates, and bolt sleeves shall be Type 316 stainless steel unless otherwise specifically indicated or specified.

C. Unless otherwise specified, stud, tap, and machine bolts shall be of the best quality refined bar iron. Hexagonal nuts of the same quality of metal as the bolts shall be used.

1.11 EXCAVATED MATERIALS

A. In the absence of special provisions in other Sections of the Specifications, equipment or supplies unearthed of any value shall be considered the property of the County and shall be cleaned and stored as directed by the Engineer. Other debris of no value shall be legally disposed of by the Contractor.

B. All excavated materials needed for backfilling operation shall be stored on site. Where

additional area is needed for stockpiling, it shall be obtained by the Contractor.

1.12 SUBSTITUTIONS

A. Make any Contractor's requests for changes in materials and equipment from those required by the Contract Documents in writing, for approval by the Engineer. Such requests are considered requests for substitutions and are subject to Contractor's representations and review provisions of the Contract Documents when one of following conditions is satisfied:

1. Where request is directly related to an "or equal" clause or other language of same effect in Specifications.

2. Where required equipment or material cannot be provided within Contract Time, but not as result of Contractor's failure to pursue Work promptly or to coordinate various activities properly.

3. Where required equipment or material cannot be provided in manner compatible with other materials of Work, or cannot be properly coordinated therewith.

B. Contractor's Options:

1. Where more than one choice is available as options for Contractor's selection of equipment or material, select option compatible with other equipment and materials already selected (which may have been from among options for other equipment and materials).

2. Where compliance with specified standard, code or regulation is required, select from among products that comply with requirements of those standards, codes, and regulations.

3. For equipment or materials specified by naming one or more equipment manufacturer and "or equal", submit request for substitution for any equipment or manufacturer not specifically named.

C. Conditions which are Not Substitution:

1. Requirements for substitutions do not apply to Contractor options on materials and equipment provided for in the Specifications.

2. Revisions to Contract Documents, where requested by the Engineer, are "changes" not "substitutions".

3. Contractor's determination of and compliance with governing regulations and orders issued by governing authorities do not constitute substitutions and do not constitute basis for a Change Order, except as provided for in Contract Documents.

D. "Or Equal" Items: Whenever a particular brand or make of material, equipment, or other item is specified, or is indicated on the Drawings, it is for the purpose of establishing a standard of quality, design, and type desired and to supplement the detailed specifications. Any other brand or make which, in the opinion of the Engineer, is equivalent to that specified or indicated may be offered as a substitute subject to the following provisions:

1. Contractor shall submit for each proposed substitution sufficient details, complete descriptive literature, and performance data together with samples of the materials, where feasible, to enable the Engineer to determine if the proposed substitution is equal.

2. Contractor shall submit certified tests, where applicable, by an independent laboratory attesting that the proposed substitution is equal.

3. A list of installations where the proposed substitution is equal.

4. Where the acceptance of a substitution requires revision or redesign of any part of the Work, all such revision and redesign, and all new Drawings and details required therefore, shall be provided by the Contractor at his own cost and expense, and shall be subject to review of the Engineer.

5. In all cases the Engineer shall be the sole judge as to whether a proposed substitution is to be accepted. The Contractor shall abide by the Engineer's decision when proposed substitute items are judged to be unacceptable and shall in such instances furnish the item, or substitute, as specified. No substitute items shall be used in the Work without written acceptance of the Engineer.

6. Acceptance of any proposed substitution shall in no way release the Contractor from any of the provisions of the Contract Documents.

7. The County may require, at the Contractor’s expense, a special performance guarantee or other surety with respect to any substitute.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

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SECTION 01660

EQUIPMENT TESTING AND STARTUP

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Equipment testing and startup are requisite to satisfactory completion of the contract and, therefore, shall be completed within the contract time. The Contractor shall allow sufficient time in its construction schedule to complete testing, troubleshooting and start-up activities.

B. As construction of the project enters the final stages of completion, the Contractor shall, in accordance with the requirements set forth in the Contract Documents, attend to the following items:

1. Schedule equipment manufacturer's visits to site.

2. Calibration of instruments and controls.

3. Perform required testing, adjusting and balancing of project components.

4. Schedule start-up and initial operation.

5. Furnish skilled personnel during initial operation.

6. Furnish operation and maintenance training to County’s personnel per requirements of the Contract documents.

1.02 EQUIPMENT TESTING

A. The Contractor shall provide the services of an experienced and authorized representative of the supplier of each item of equipment (excluding minor items of equipment specifically exempted by the Engineer in writing), who shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the Contractor shall arrange to have the supplier's representative revisit the job site as often as necessary until any and all problems are corrected and the equipment installation and operation are satisfactory to the Engineer. The Contractor shall provide effective coordination of all parties necessary for complete system testing, including component suppliers, subcontractors, the Engineer, and the Owner.

B. The Contractor shall require that each supplier's representative furnish to the Engineer a written report addressed to the County, and copied to the Engineer, certifying that the equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchor bolts, has been

operated satisfactorily under full-load conditions, is ready for operation and the County's operating personnel have been instructed in the operation, maintenance and lubrication of the equipment.

C. The Contractor shall be responsible for scheduling all operations testing. The Contractor is advised that the Engineer and the County's operating personnel will witness operations testing.

D. The supplier's representative shall instruct the County's operating personnel in correct operation and maintenance procedures utilizing the O&M Manuals as a basis for instruction. The instruction shall demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment. Such instruction shall be scheduled at a time arranged with the Engineer at least two weeks in advance and shall be provided while the respective representative's equipment is fully operational. On-site instruction shall be given by qualified persons who have been made familiar in advance with the equipment and systems in the plant. The Contractor shall have submitted, and had accepted, the O&M Manuals specified in Section 01300 entitled "Submittals" prior to commencement of training.

E. The Contractor shall notify the Engineer at least 14 days in advance of each equipment test or County training session.

F. Training shall be provided to one shift of the County's personnel during normal working hours.

G. The Contractor shall furnish all personnel, power, water, chemicals, fuel, oil, grease, and all other necessary equipment, facilities, and services required for conducting the tests except as otherwise accepted by the Engineer.

1.03 STARTUP

A. The Contractor shall provide operating personnel for the duration of the startup. The Contractor shall also provide all water, power, chemicals and other consumables required. Additionally, the Contractor shall provide the effective coordination of all parties necessary for the successful startup, including suppliers, subcontractors, the Engineer, and the County.

B. It is not the intent of the Engineer to instruct the Contractor in the startup of the facilities; however, the Engineer will be available prior to and during startup to provide technical support to the Contractor.

C. The Contractor shall be required to startup the equipment, under direction of the Engineer, and operate it for a continuous one-day (24 hours) period at design conditions. The Contractor shall be available at all times during this period to provide necessary maintenance support services as may be deemed necessary by the Engineer.

D. Not less than two months prior to startup, the Contractor shall submit to the Engineer for review, a detailed schedule of operations which will be necessary to effect a successful initial operation and sustained period of operation for the duration of the required startup period.

E. The startup shall not be commenced until all required leakage tests, disinfection, and equipment tests, as applicable, have been completed to the satisfaction of the Engineer.

F. All defects in materials or workmanship which appear during this startup period shall be immediately corrected by the Contractor. Time lost for equipment repairs, wiring corrections, control point settings, or other reasons which actually interrupt the startup may, at the discretion of the Engineer, be justifiable cause for extending the startup test duration.

G. During the startup, the Contractor shall provide the services of authorized representatives of the suppliers, in addition to those services required under operations testing, as necessary, to correct faulty equipment operation.

H. During the startup, the Contractor shall keep records of the operations, in accordance with the instructions of the Engineer.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

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SECTION 01700

PROJECT CLOSEOUT

PART 1 -- GENERAL

1.01 FINAL CLEANUP; SITE REHABILITATION

A. Before finally leaving the site, the Contractor shall wash and clean all exposed surfaces which have become soiled or marked, and shall remove from the site of work all accumulated debris and surplus materials of any kind which result from his operation, including construction equipment, tools, sheds, sanitary enclosures, etc. The Contractor shall leave all equipment, fixtures, and work, which he has installed, in a clean condition. The completed project shall be turned over to the County in a neat and orderly condition.

B. The site of the work shall be rehabilitated or developed in accordance with other sections of the Specifications and the Drawings. In the absence of any portion of these requirements, the Contractor shall completely rehabilitate the site to a condition and appearance equal or superior to that which existed just prior to construction, except for those items whose permanent removal or relocation was required in the Contract Documents or ordered by the County.

1.02 FINAL INSPECTION

A. Final cleaning and repairing shall be so arranged as to be finished upon completion of the construction work. The Contractor shall make his final cleaning and repairing, and any portion of the work finally inspected and accepted by the COUNTY, and the work shall be kept clean by the Contractor, until the final acceptance of the entire work..

1.03 CLOSE OUT PROCEDURE

A. As construction of the project enters the final stages of completion, the Contractor shall, in concert with accomplishing the requirements set forth in the Contract Documents, attend to or have already completed the following items as they apply to his contract:

1. Equipment manufacturers' site visit requirements.

2. Required testing of project components.

3. Start-up and initial operation.

4. Corrected or replaced defective work, including completion of items previously overlooked or work which remains incomplete.

6. Attend to any other items listed herein or brought to the Contractor's attention by the COUNTY.

B. Just before the Engineer's Certificate of Substantial Completion is issued, the Contractor shall accomplish the cleaning and final adjustment of the various building components as specified in the Specifications and as follows:

1. Clean all glass and adjust all windows and doors for proper operation.

2. Clean all finish hardware after adjustment for proper operation.

3. Touch up marks or defects in painted surfaces and touch up any similar defects in factory finished surfaces.

4. Wax all resilient flooring materials.

5. Remove bitumen from gravel stops, fascias, and other exposed surfaces.

6. Remove all stains, marks, fingerprints, soil, spots, and blemishes from all finished surfaces, tile, stone, brick, and similar surfaces.

C. In addition, and before the Certificate of Substantial Completion is issued, the Contractor shall submit to the COUNTY certain records, certifications, etc., which are specified elsewhere in the Contract Documents. A partial list of such items appears below, but it shall be the Contractor's responsibility to submit any other items which are required in the Contract Documents:

1. Test results of project components.

2. Performance Affidavits for equipment.

3. Certification of equipment or materials in compliance with Contract Documents.

4. Operation and maintenance instructions or manuals for equipment.

5. One set of neatly marked-up record drawings showing as-built changes and additions to the work under his Contract.

6. Digital electronic file for certified survey of as-built conditions

7. Any special guarantees or bonds (Submit to County).

D. The Contractor's attention is directed to the fact that required certifications and information under Item 3 above, must actually be submitted earlier in accordance with the sequence of construction and other Sections of the Specifications.

E. COUNTY and CONTRACTOR shall meet and resolve all outstanding issues including, but not limited to:

1. Claims and adjustments for time or costs

2. Outstanding, unused allowances

3. Procedures for handling warranty issues

F. A Final Change Order shall be processed if required. Final payment and close out procedures shall comply with all other requirements of the Contract Documents.

1.04 COMPLETION PROCEDURES

A. Substantial Completion is defined as that point that work has sufficiently progressed that the COUNTY may take beneficial use of the improvements and all work has been fully completed and ready for final inspection. When the CONTRACTOR believes Substantial Completion has been achieved, CONTRACTOR shall request, in writing, that Substantial Completion be recognized as having been achieved and request that the COUNTY issue a Certificate of Substantial Completion. Prior to making such a request, the CONTRACTOR must have:

1. Completed all operational testing successfully and all work necessary for the safe, proper and complete use or operation of the facility as intended so work can be safely utilized for the purpose for which it was intended.

2. All regulatory agency requirements are satisfied to clear systems for permission to place in service.

3. All ancillary components have been completed and accepted including paving and site restoration and a County approved punch list has been generated and submitted for submission with the request for issuance of a Certificate of Substantial Completion.

4. Submitted for and received acceptance of accurate record drawings for all WORK completed to date.

5. Submitted and received acceptance of all specified warranties, guarantees and operation and maintenance manuals.

6. Completed all required vendor training, testing, and where required, start-up.

7. Delivered all required spare parts.

B. Upon receipt of the request from the CONTRACTOR, the COUNTY and designated representatives shall review the request, the WORK and the above requirements to determine whether the CONTRACTOR has achieved Substantial Completion. If this review fails to support Substantial Completion, the COUNTY shall so notify the CONTRACTOR in writing citing the reasons for rejection. If the COUNTY determines the CONTRACTOR has reached Substantial Completion, the following procedures will be followed:

1. The COUNTY and/or representative(s) will review the WORK and the CONTRACTOR's punch list during a walkthrough of the work to assure all

deficiencies are noted on a final punch list. A copy of the final punch list will be provided to all participants and any additional items noted during the walk-through will be added to the list.

2. Upon completion of the pre-final walk-through the COUNTY will prepare a Certificate of Substantial Completion establishing the date for Substantial Completion as the date of the walk-through, provided the walk-through has verified that the Project is in fact ready for use and occupancy by the COUNTY for its intended purpose. Upon issuance of this certificate by the facility will be considered Substantially Complete.

3. For any scheduling delay behind the contractual milestone due dates, the Contractor is responsible for paying all Consultant and inspector expenses at their prevailing rate beyond the milestone date and until the milestone is achieved. The County has the authority to deduct all costs from any partial payment otherwise due the Contractor. Also, the Contractor agrees to pay all the costs for any delay beyond the final completion of the Contract milestone due date.

C. Final Completion will be deemed to have occurred when all WORK is completed including the following:

1. All final punch list items have been corrected, signed off by the CONTRACTOR and the COUNTY as demonstrated to the COUNTY during a final inspection.

2. All updates to the record drawings, and operations and maintenance manuals have been made.

3. Demobilization and site cleanup are complete.

4. The COUNTY has issued a Certificate of Final Completion.

5. All facilities and/or equipment have been properly demonstrated to be functioning as required and all general conditions have been met

6. The CONTRACTOR has obtained Certificates of Occupancy from the County Building Department indicating all re-inspection requirements have been performed satisfactorily, all fees have been paid, and all other requirements of the Building Department have been met.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

- END OF SECTION -

DIVISION 2

Sitework

SECTION 02050

DEMOLITION

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall remove and dispose of or salvage any existing structure, piping, conduits, electrical equipment, mechanical equipment, or appurtenances or portions thereof, as shown on the Drawings and specified herein or required to complete the project.

B. All materials designated for disposal shall, when released by the Engineer, become the Contractor's property and shall be removed from the site and disposed of by the Contractor.

C. All materials designated to be salvaged shall be carefully removed and moved to a County-designated location.

1.02 SUBMITTALS

A. The Contractor shall submit for review, in accordance with Section entitled "Submittals" the proposed methods, equipment and operation sequence. Include coordination for shut-off, temporary services, continuation of service and other applicable items to ensure no interruption of operations except as herein before specified.

1.03 JOB CONDITIONS

A. The Contractor shall execute the demolition and removal work to prevent damage or injury to structures, occupants thereof and adjacent features which might result from falling debris or other causes, and so as not to interfere with the use, and free and safe passage to and from adjacent structures.

B. Closing or obstructing of roadways adjacent to the work by the placement or storage of materials will not be permitted. All operations shall be conducted with a minimum interference to traffic on these ways.

C. The Contractor shall repair damage done to facilities to remain, or any property belonging to the County.

D. Scheduling: The Contractor shall carry out his operations so as to avoid interference with operations and work in the existing facilities.

E. Notification: At least seven (7) calendar days prior to commencement of a demolition or removal, the Contractor shall notify the County in writing of his proposed removal schedule. No removals shall be started until the schedule is acceptable to the County.

F. Limited Record Drawings of existing structures, foundations and utilities are available upon request as a reference for the Contractor's information purposes only.

1.04 DUST CONTROL

A. The Contractor shall use temporary enclosures and other suitable methods to limit the amount of dust and dirt rising and scattering in the air to the lowest practical level. Existing electrical and mechanical equipment to remain shall be protected from damage, dust, and debris.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION

3.01 GENERAL

A. Prior to commencing work, the Contractor shall check all underground and exposed existing utility and process piping and all equipment in any way associated or in the proximity to the items to be removed and shall verify that the piping is inactive (abandoned) and that electric power to equipment, lighting, controls, etc., has been permanently disconnected. Active services shall be brought to the attention of the County for proper action.

B. The Contractor shall remove all equipment and accessories in a workmanlike manner and shall take all necessary precautions to avoid damaging existing equipment, piping, and structure which are to be retained. Damages shall be repaired or replaced at the expense of the Contractor.

C. The Contractor shall proceed with the removal of the structures, equipment, piping, and appurtenances in a sequence designed to maintain the facilities in continuous operation.

D. All supports, pedestals, and anchors shall be removed with the equipment structures and piping unless otherwise specified or required. Concrete bases, anchor bolts, and other supports shall be removed in their entirety; and the recesses shall be patched to match the adjacent areas. Superstructure wall and roof openings shall be closed, damaged surfaces shall be patched to match the adjacent areas, as specified under applicable sections of these Specifications, and as shown on the Drawings, or as indicated by the Engineer. Wall sleeves and castings shall be cleared of extraneous materials and filled with non-shrink grout as recommended by manufacturer for water-tightness required, All openings in concrete shall be closed in a manner meeting the requirements of the appropriate sections of these Specifications, as shown on the Drawings, and as acceptable to the Engineer.

3.02 UNAUTHORIZED REMOVAL

A. Any equipment, piping, and appurtenances removed without proper authorization, shall be replaced to the satisfaction of the Engineer at no cost to the County.

3.03 SALVAGED ITEMS

A. Items to be salvaged shall be tagged and shall remain the property of the County. The Contractor shall carefully move salvaged equipment to a County designated location. Items to be salvaged are as follows:

1. Lift Station float and level sensor

2. Lift Station Pumps

3. Jib Crane

4. Sodium Hypochlorite Pumps

3.04 DEMOLITION

A. All materials and equipment shown on the Drawings to be removed or demolished shall become the property of the Contractor, with the exception of items tagged by the County to be salvaged as noted under “Salvaged Items” or as otherwise directed by the County. County has first right to any items or equipment scheduled to be removed as part of this project. Contractor shall check with County prior to removing any item for disposal to ascertain from the County whether or not the particular item or items are to be salvaged. The Contractor shall dispose of all demolition materials, equipment, debris and all other items off the project site and in conformance with all existing applicable laws and regulations.

3.05 STRUCTURAL REMOVALS

A. The Contractor shall remove structures to the lines and grades shown, unless otherwise indicated by the Engineer.

B. All wood, concrete, brick, tile, concrete block, roofing materials, reinforcement, structural or miscellaneous metals, plaster, wire mesh and other items contained in or upon the structure shall be removed and taken from the project site. These items shall not be used in backfill.

C. Finishes: After removal of parts or all of masonry walls, slabs and like work, which tie into new work or existing work, the point of junction shall be neatly repaired so as to leave only finished edges and surface exposed. The jambs, sills and heads of any new windows, passageways, doors or other openings cut into the new work or existing work shall be dressed with new masonry, concrete or metal to provide a smooth, finished appearance.

D. Anchoring: Where new anchoring materials, including bolts, nuts, hangers, welds and reinforcing steel, are required to attach new work to the existing work, they shall be included under this Section, except where specified elsewhere.

3.06 MECHANICAL REMOVALS

A. General: Mechanical removals shall consist of dismantling and removing of existing piping, equipment and other appurtenances as shown or required for the completion of the work. It shall include cutting, capping and plugging as required.

B. Wherever piping is to be removed, adjacent pipe headers that are to remain in service shall be blanked off or plugged and then anchored in an acceptable manner.

3.07 ELECTRICAL REMOVALS

A. General: Electrical removals shall consist of the removal of conduits and wires, and miscellaneous electrical equipment all as shown, specified or required to perform the work.

3.08 REPAIR WORK

A. Certain areas of existing structures, piping, conduits, and the like will be affected by work necessary to complete modifications under this Contract. The Contractor shall be responsible to rehabilitate those areas affected by its construction activities.

B. Where new rectangular openings are to be installed in concrete or concrete masonry walls or floors, the Contractor shall score the edges of each opening (both sides of wall or elevated slab) by saw cutting clean straight lines to a minimum depth of one inch and then chipping out the concrete. Alternately, the opening can be formed by saw cutting completely through the slab or wall. Saw cuts deeper than one inch (or the depth of cover over existing reinforcing steel, whichever is less) shall not be allowed to extend beyond the limits of the opening. Corners shall be made square and true by a combination of core drilling, chipping, or grinding. All necessary precautions shall be taken during removal of concrete to prevent debris from falling and damaging adjacent equipment or piping. Saw cuts allowed to extend beyond the opening shall be repaired by filling with nonshrink grout. The concrete around any exposed reinforcement steel shall be chipped back and exposed reinforcement steel cut a minimum of 1-1/2 inches from the finished face of the new opening. The inside face of the new opening shall be grouted to fill any voids and cover the exposed aggregate and shall be trowel-finished to provide a plumb and square opening.

C. Where new conduit or piping is to be installed through existing concrete walls, the Contractor shall accurately position and core-drill openings. Openings shall be adequately sized to allow alignment of piping or conduit and fittings without deflection

and to provide adequate clearance for satisfactory packing in the annular space between the piping or conduit and the core drilling opening as shown on the Drawings.

D. Where new piping is to be connected to existing piping, the existing piping shall be cut square and the ends properly prepared for the connection shown on the drawings. Any damage to the lining and coating of the existing piping shall be repaired by the Contractor.

E. Where existing equipment, equipment pads and bases, piping, piping supports, handrail, electrical panels and devices, conduits, and associated appurtenances are removed, the Contractor shall rehabilitate the affected area such that little or no evidence of the previous installation remains. Openings in concrete floors, walls, and ceiling from piping, conduit, fastener penetrations, etc., shall be filled with nonshrink grout and finished to match the adjacent area. Concrete pads and bases for equipment and supports shall be removed by chipping away concrete and cutting any exposed reinforced steel and anchor bolts a minimum of 1-1/2 inches below finished grade. The area of concrete to be rehabilitated shall be scored by saw cutting clean, straight lines to a minimum depth of 1-1/2 inches, and all concrete within the scored lines removed to a minimum depth of 1-1/2 inches. The area within the scored lines shall be patched with nonshrink grout to match the adjacent grade and finish. Unless otherwise shown, abandoned connections to piping and conduits shall be terminated with blind flanges, caps, and plugs suited for the material, type, and service of the pipe or conduit. Walls shall be painted in accordance with requirements set forth in Section entitled "Painting".

F. Where existing structural steel members are removed or modified, the surface of the remaining existing steel members damaged by construction activities shall be repaired. The affected areas shall be surface prepared and coated in accordance with Section entitled "Painting".

G. Disposal of Debris: All debris, materials, piping, and miscellaneous waste products from the work described in this section shall be removed from the project as soon as possible. They shall be disposed of in accordance with applicable federal, state, and local regulations. The Contractor is responsible for determining these regulations and shall bear all costs or retain any profit associated with disposal of these items.

3.09 CLEANUP

A. The Contractor shall remove from the project site all debris resulting from the demolition and removal operations as it accumulates. Upon completion of the demolition work, all materials, equipment, waste and debris of every sort shall be removed and the premises shall be left clean, neat and orderly.

- END OF SECTION –

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SECTION 02140

DEWATERING

PART 1 -- GENERAL

1.01 WORK INCLUDED

A. Furnish all labor, materials, and equipment, perform all work necessary to lower and control the groundwater levels and hydrostatic pressures to permit all excavations and construction to be performed in dry conditions. The work shall include the following:

1. Testing, operation, maintenance, supervision, rewatering, and final dismantling and removal from the site of the dewatering system.

2. The cost of any replacement or rehabilitation of the subgrade or structures damaged due to dewatering system failures or Contractor negligence.

3. Compliance with all regulations relating to this work.

4. The diversion, collection, and removal of all ice, snow and surface runoff from the work areas, and removal of groundwater from new excavations to permit construction in the dry.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Requirements of related work are included in Division 1 and Division 2 of these Specifications.

1.03 REFERENCE SPECIFICATIONS CODES AND STANDARDS

A. Without limiting the generality of other requirements of these Specifications, all work herein shall conform to or exceed the applicable requirements of the following documents to the extent that the provisions therein are not in conflict with the requirements of this Section.

1.	ASTM D1556	Density of soil in place by the Sand Cone Method.
2.	ASTM D2167	Density of soil in place by the Rubber Balloon Method.
3.	Bureau of Reclamation Cone	Groundwater Manual Sediment Test by Imhoff

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01300, Submittals:

1. Name of dewatering subcontractor, if applicable

2. Shop Drawings indicating the following:

   a. Plans showing the methods and location of dewatering and discharge including a sufficient number of detailed sections to clearly illustrate the scope of work.

   b. Relationship of the dewatering system, observation wells, and discharge line to existing buildings, other structures, utilities, streets and new construction.

   c. Utility locations.

   d. Drawings shall bear the seal and signature of the qualified Registered Professional Engineer in charge of preparing the drawings.

   e. List of materials and equipment to be used.

   f. A sample of all well record forms to be maintained during construction.

3. Detailed description of the sequence of dewatering operations

4. Dewatering well installation records indicating an identification number, location, dimensions, and installation procedures and materials.

5. Observation well installation records indicating an identification number, location, dimensions, and installation procedures and materials.

6. Emergency observation plan to be put into operation during failure of the dewatering system

7. Monthly Dewatering System Monitoring Reports containing the following data on approved forms:

   a. For observation wells, daily piezometric levels shall be identified by date, time, well number and system (subsystem if multiple pumps are used) pumping rate. Piezometric levels shall be noted in feet of drawdown and groundwater elevation.

   b. For dewatering wells, suspended material test results shall be identified by date, time, well number, well pumping rate (if monitored) and system (subsystem if multiple pumps are used) pumping rate.

   c. Installation records for new wells.

8. Schedule and records of all maintenance tests for primary and standby dewatering systems including the following:

a. Maintenance tests and water quality tests for suspended matter at the discharge point including date, time of day, elapsed times of tests procedures, components tested, suspended particles, resultant observations and well readings.

b. Daily discharge rates.

c. Installation and removal of wells.

d. General observations of the system such as equipment running times, and failures.

9. Dewatering well removal records

10. Observation well removal records

1.05 QUALITY ASSURANCE

A. The Contractor shall be solely responsible for the arrangement, location, and depths of the dewatering system necessary to accomplish the work described herein.

B. Dewatering shall prevent the loss of fines, seepage, boils, quick conditions or softening of the foundation strata while maintaining stability of the sides and bottom of the excavation and providing dry conditions for construction operations.

PART 2 -- PRODUCTS

2.01 MATERIALS

A. Materials, especially the well screen, shall be carefully chosen to be compatible with the environment to prevent erosion, deteriorization, and clogging.

B. Surging of the natural formation to form a "gravel pack" is strictly prohibited.

PART 3 -- EXECUTION

3.01 EXAMINATION OF THE SITE

A. Become familiar with the surface and subsurface site conditions.

B. Obtain the data required to analyze the water and soil environment at the site in order to assure that the materials used for the dewatering systems will not erode, deteriorate, clog or otherwise hinder the system's performance during the period of the dewatering.

C. Prior to the execution of the work, the Contractor, Owner and Engineer shall jointly survey the condition of adjoining structures. Photographs and records shall be made of

any prior settlement or cracking of structures, pavements, and the like, that may become the subject of possible damage claims.

3.02 DESIGN

A. The dewatering system shall be capable of relieving all hydrostatic pressure against the height of the excavation walls and of lowering the hydrostatic level below the bottom of the base slab a minimum of four (4) feet in the work areas both prior to excavation, and during excavation and construction.

B. The dewatering system shall be segmented so that if the operation of any one segment is disrupted, the remaining segment plus activated redundant components are capable of maintaining the groundwater at the stated levels.

C. Provide, operate and maintain all ditches, berms, site grading, sumps and pumping facilities to divert, collect and remove all surface water from work areas. All collected water shall be discharged into the outfall pipe.

D. Provide pipe and pumps of sufficient size and quantity to be able to flood the excavation within 12 hours in an emergency situation. Restoration of the working area shall be carried out by the Contractor at no additional cost to the Owner.

E. Carry the dewatering system discharge through pipes out of the area of the excavation into the outfall junction manhole shown on the Drawings. Provide meters to measure the discharge flow.

F. Place a portion of the header and discharge system underground to provide vehicle crossings or access to existing structure as required.

G. Provide a standby dewatering system that meets the following requirements:

1. Provide 100 percent standby power.

2. Provide a 15 percent minimum increase in the number of wells and related equipment required to operate the dewatering system installed and ready to operate.

3. Provide a minimum of three separate power units for the standby power system and one installed auxiliary unit for each individually powered pump.

4. Provide separate discharge lines from each well or common lines with valves such that any well or wells that malfunction or are damaged can be isolated form the others.

5. The systems shall be laid out and designed in such a way that portions of the system may be isolated for routine maintenance or repair in case of accidental damage without affecting the normal operation of the system.

H. Provide sufficient fuel to maintain a five day supply on site for fuel power systems.

I. Provide observation wells to determine compliance with dewatering requirements as indicated on the Drawings, Shop Drawings, and the Engineer.

J. Designate certain observation wells as emergency observation wells.

3.03 INSPECTION

A. All tests and inspections require the witnessing and written approval of the Owner and Engineer.

B. Provide safe access for the owner and Engineer to perform testing and inspection.

C. The Owner and Engineer will provide oral and written notice to the Contractor for all tests and inspections that do not meet approval.

3.04 INSTALLATION AND TESTING

A. Install the dewatering system from the existing ground surface or from the bottom of an excavation which is located above the natural groundwater level.

B. Pump each well individually at its maximum or design flow and take a water sample using the following procedures:

1. Obtain samples from stopcocks located along the discharge lines at points of high turbulence or between 4 and 8 o'clock on the perimeter of straight sections of pipe.

2. Flush the stopcock for a few seconds before taking a sample.

3. Take a 1-liter sample with the stopcock fully open.

C. Test the sample following the Sediment Test by Imhoff Cone for two to three minutes and measure the volume of settled materials to the nearest 0.01 milliliters (0.01 milliliters = 10 ppm).

D. All wells shall be evaluated as follows:

1. Wells producing 10 ppm or less shall be accepted.

2. Wells producing between 10 and 20 ppm may be accepted by the Engineer based on the evaluation of average ppm for all wells, ppm of adjacent wells, and total quantity of water which is actually pumped to dewater the excavation.

3. Well producing more than 20 ppm shall be abandoned and backfilled.

E. Observation wells shall consist of a standpipe or riser of minimum 1.0-inch inside diameter and a minimum three (3) foot long well-point screen or slotted PVC section at the bottom. Observation wells shall be installed as follows:

1. Employ the jetting method for all observation wells except those within ten feet of existing structures, piping or utilities.

2. Employ Case Boring Techniques for all observation wells within ten feet of existing structures, piping, or utilities and backfill the annulus between the well point or riser and the natural soil with a free-flowing granular material similar to Ottawa Sand.

F. Test observation wells by adding or removing water from the riser to demonstrate their proper functioning.

3.05 DEWATERING PROCEDURE

A. Following soldier pile installation and dewatering system installation and testing and prior to excavation, place the dewatering system into operation and lower the water level.

B. Schedule the dewatering work to coordinate with all the other related work such as excavation, sheeting and tiebacks, pouring of concrete walls and slabs, and any other operations by other Contractors that might be affected by this work.

C. Test the standby dewatering system with the following procedures:

1. Shut off the primary power source and demonstrate that the standby power can be activated prior to the groundwater level rising to within one (1) foot of the bottom of base slab elevation and that the standby power source is adequate to draw the groundwater level back down to the Contractor's design depth or to the minimum required depths.

2. Shut off one segment of the system and show that redundant components can be activated prior to the groundwater level rising to within one (1) foot of the bottom of base slab elevation and that the system is adequate to draw the groundwater level back down to the Contractor's design depth or to the minimum required depths.

3. If the dewatering system fails to meet either performance requirement, the Contractor shall draw the groundwater level to a greater depth, add wells, or modify the system such that it will be in conformance with these requirements when retested.

D. Operate the dewatering system continuously twenty-four (24) hours per day, seven (7) days per week until all structures have been satisfactorily constructed, including placement of fill materials, and no longer require dewatering.

3.06 MONITORING

A. Measure the piezometric water levels to the nearest one-tenth foot in all observation wells and submit the readings daily.

B. Measure the concentration of suspended material in the discharge water of each well once every two days. Wells which exceed the acceptable level of solids concentration shall be replaced.

C. Test the performance of the standby system and all components by demonstrating that the system is operational at least every two weeks.

D. Test the observation wells every two weeks by adding and removing water from the risers to demonstrate their proper functioning.

E. Observation wells that become inoperable shall be immediately replaced while construction is halted if the Engineer determines that the observation well is critical.

F. Remove and add riser pipe of each observation well located within the excavation as construction progresses until the well conflicts with the structure. When the conflict occurs, abandon the observation well, fill it with grout, and cut the riser off at grade.

G. In the event of a dewatering system failure, take the following steps:

1. Conduct in situ density tests conforming to ASTM D1556 or ASTM D2167 immediately above an at the structure founding grades.

2. Remove all soils that show unacceptable density and replace them with compacted fill as indicated in Section 02200, Earthwork.

3. Test the repaired soils as required by the Owner and Engineer to verify that they have been returned to their original in situ state or better.

4. Repair or replace damaged structures.

3.07 REWATERING AND REMOVAL OF DEWATERING SYSTEM

A. Obtain written approval from the Owner and Engineer to being rewatering operations.

B. Provide an adequate weight of fill to prevent buoyancy.

C. Pump water into the excavation such that the water level inside the excavation is always at a higher level than the rising groundwater on the outside until the groundwater level has reached its static level.

D. Remove all dewatering wells, buried and surface piping, cables, pump foundations, structural supports and all other support facilities.

E. Backfill as specified in Section 02200, Earthwork, all trenches and excavations below final grades or in fill areas.

F. Provide documentation of dewatering and observation well removal including the date of removal, well number, location, procedures, and materials used.

- END OF SECTION -

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SECTION 02200

EARTHWORK

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all labor, equipment and materials required to complete all work associated with excavation, including off-site borrow excavation, dewatering, backfill, drainage layers beneath and around structures, foundation and backfill stone, filter fabric, embankments, stockpiling topsoil and any excess suitable material in designated areas, in place compaction of embankments, backfill and subgrades beneath foundations and roadways, excavation support, disposing from the site all unsuitable materials, providing erosion and sedimentation control grading, site grading and preparation of pavement and structure subgrade, and other related and incidental work as required to complete the work shown on the Drawings and specified herein.

B. All excavations shall be in conformity with the lines, grades, and cross sections shown on the Drawings or established by the Engineer.

C. It is the intent of this Specification that the Contractor conduct the construction activities in such a manner that erosion of disturbed areas and off-site sedimentation be absolutely minimized.

D. All work under this Contract shall be done in conformance with and subject to the limitations of the latest editions of the Florida Department of Transportation Standard Specifications for Road and Bridge Construction and the State of Florida Erosion and Sediment Control Designer and Review Manual.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Requirements of related work are included in Division 1 and Division 2 of these Specifications.

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced Specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Department of Transportation Standard Specifications for Road and Bridge Construction, latest edition.

2. American Society for Testing and Materials (ASTM):

ASTM C 127 Test for Specific Gravity and Absorption of Coarse Aggregate.

ASTM C 136 Test for Sieve Analysis of Fine and Coarse Aggregates.

ASTM D 422	Particle Size Analysis of Soils.
ASTM D 423	Test for Liquid Limit of Soils.
ASTM D 424	Test for Plastic Limit and Plasticity Index of Soils.
ASTM C 535	Test for Resistance to Degradation of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
ASTM D 698	Standard Method of Test for the Moisture - Density Relations of Soils Using a 5.5 lb. (2.5 kg) Rammer and a 12-inch (305 mm) Drop.
ASTM D1556	Test for Density of Soil in Place by the Sand-Cone Method.
ASTM D1557	Test for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10-lbs. (4.5 kg) Rammer and 18-inch (457 mm) Drop.
ASTM D2049	Test Method for Relative Density of Cohesionless Soils.
ASTM D2167	Test for Density of Soil in Place by the Rubber-Balloon Method.
ASTM D2216	Test for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil Aggregate Mixtures.
ASTM D2487	Test for Classification of Soils for Engineering Purposes.
ASTM D2922	Test for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

1.04 SUBSURFACE CONDITIONS

A. Information on subsurface conditions is referenced under Division 1, General Requirements.

B. Attention is directed to the fact that there may be water pipes, storm drains and other utilities located in the area of proposed excavation. Perform all repairs to same in the event that excavation activities disrupt service.

1.05 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01300 - Submittals, the Contractor shall submit the following:

1. Name and location of all material suppliers.

2. Certificate of compliance with the standards specified above for each source of each material.

3. List of disposal sites for waste and unsuitable materials and all required permits for use of those sites.

4. Plans and cross sections of open cut excavations showing side slopes and limits of the excavation at grade.

5. Samples of synthetic filter fabric and reinforced plastic membrane with manufacturer's certificates or catalog cuts stating the mechanical and physical properties. Samples shall be at least one (1) foot wide and four (4) feet long taken across the roll with the warp direction appropriately marked.

6. Construction drawings and structural calculations for any types of excavation support required. Drawings and calculations shall be sealed by a currently registered Professional Engineer in the State of Florida.

7. Monitoring plan and pre-construction condition inspection and documentation of all adjacent structures, utilities, and roadways near proposed installation of excavation support systems and near areas where dewatering is required to facilitate construction.

8. Dewatering procedures.

1.06 PRODUCT HANDLING

A. Soil and rock material shall be excavated, transported, placed, and stored in a manner so as to prevent contamination, segregation and excessive wetting. Materials which have become contaminated or segregated will not be permitted in the performance of the work and shall be removed from the site.

1.07 USE OF EXPLOSIVES

A. When the use of explosives is necessary for the prosecution of the work, the Contractor shall exercise the utmost care not to endanger life or property. The Contractor shall be responsible for any and all damage or injury to persons or property resulting from the use of explosives. Use of explosives shall be in accordance with Specification Section 02202, Excavation By Blasting.

PART 2 -- PRODUCTS

2.01 SELECT FILL

A. Soils from the excavations meeting requirements stipulated herein with the exceptions of topsoil and organic material may be used as select fill for backfilling, constructing embankments, reconstructing existing embankments, and as structural subgrade support.

B. Select fill used for embankment construction shall be a silty or clayey soil material with a Maximum Liquid Limit (LL) of 50 and a Plasticity Index (PI) between 7 and 20.

C. Select fill used for backfilling shall either be material as described in Paragraph B above or a granular soil material with a Maximum Plasticity Index (PI) of 6.

D. Regardless of material used as select fill, materials shall be compacted at a moisture content satisfactory to the Engineer, which shall be approximately that required to produce the maximum density except that the moisture content shall not be more than 2% below nor more than 2% above the optimum moisture content for the particular material tested in accordance with the ASTM D698.

E. Select fill used as subgrade support shall be a coarse aggregate material meeting the gradation requirements of #57 or #78 aggregates in accordance with ASTM C-33, or Aggregate Base Course (ABC) as defined in Section 02207 – Aggregate Materials.

F. Where excavated material does not meet requirements for select fill, Contractor shall furnish off-site borrow material meeting the specified requirements herein. Determination of whether the borrow material will be paid for as an extra cost will be made based on Article 4 of the General Conditions, as amended by the Supplementary Conditions. When the excavated material from required excavations is suitable for use as backfill, bedding, or embankments, but is replaced with off-site borrow material for the Contractor's convenience, the costs associated with such work and material shall be borne by the Contractor.

2.02 TOPSOIL

A. Topsoil shall be considered the surface layer of soil and sod, suitable for use in seeding and planting. It shall contain no mixture of refuse or any material toxic to plant growth.

2.03 FOUNDATION DRAINAGE SYSTEMS

A. The Contractor shall provide foundation drainage systems as indicated on the Drawings and specified herein. The materials and placement shall be as indicated under Section 02712 - Foundation Drainage Systems.

2.04 GEOTEXTILES

A. The Contractor shall provide geotextiles as indicated on the Drawings and specified herein. The materials and placement shall be as indicated under Section 02274 - Geotextiles.

PART 3 -- EXECUTION

3.01 STRIPPING OF TOPSOIL

A. In all areas to be excavated, filled, paved, or graveled the topsoil shall be stripped to its full depth and shall be deposited in storage piles on the site, at locations designated by the Engineer, for subsequent reuse. Topsoil shall be kept separated from other excavated materials and shall be piled free of roots and other undesirable materials.

3.02 EXCAVATION

A. All material excavated, regardless of its nature or composition, shall be classified as UNCLASSIFIED EXCAVATION. Excavation shall include the removal of all soil, rock, weathered rock, rocks of all types, boulders, conduits, pipe, and all other obstacles encountered and shown to be removed within the limits of excavation shown on the Drawings or specified herein. The cost of excavation shall be included in the Lump Sum Bid Price and no additional payment will be made for the removal of obstacles encountered within the excavation limits shown on the Drawings and specified herein.

B. Where blasting is necessary to perform the required excavations, blasting shall be performed as stipulated in Section 02202, Excavation By Blasting.

C. All suitable material removed in the excavation shall be used as far as practicable in the formation of embankments, subgrades, and shoulders, and at such other places as may be indicated on the Drawings or indicated by the Engineer. No excavation shall be wasted except as may be permitted by the Engineer. Refer to the drawings for specific location and placement of suitable excavated materials in the formation of embankments, backfill, and structural and roadway foundations. THE ENGINEER AND/OR MATERIALS TESTING CONSULTANT WILL DESIGNATE MATERIALS THAT ARE UNSUITABLE. The Contractor shall furnish off site disposal areas for the unsuitable material. Where suitable materials containing excessive moisture are encountered above grade in cuts, the Contractor shall construct above grade ditch drains prior to the excavation of the cut material when in the opinion of the Engineer and/or materials testing consultant such measures are necessary to provide proper construction.

D. All excavations shall be made in the dry and in such a manner and to such widths as will give ample room for properly constructing and inspecting the structures and/or piping they are to contain and for such excavation support, pumping and drainage as may be required. Excavation shall be made in accordance with the grades and details shown on the Drawings and as specified herein.

E. Excavation slopes shall be flat enough to avoid slides that will cause disturbance of the subgrade or damage of adjacent areas. Excavation requirements and slopes shall be as indicated in the Drawings. The Contractor shall intercept and collect surface runoff both at the top and bottom of cut slopes. The intersection of slopes with natural ground surfaces, including the beginning and ending of cut slopes, shall be uniformly rounded as shown on the Drawings or as may be indicated by the Engineer. Concurrent with the excavation of cuts the Contractor shall construct intercepting berm ditches or earth berms along and on top of the cut slopes at locations shown on the Drawings or designated by the Engineer. All slopes shall be finished to reasonably uniform surfaces acceptable for seeding and mulching operations. No rock or boulders shall be left in place which protrude more than 1 foot within the typical section cut slope lines, and all rock cuts shall be cleaned of loose and overhanging material. All protruding roots and other objectionable vegetation shall be removed from slopes. The Contractor shall be required to submit plans of open-cut excavation for review by the Engineer before approval is given to proceed.

F. It is the intent of these Specifications that all structures shall bear on an aggregate base, crushed stone or screened gravel bedding placed to the thickness shown on the Drawings, specified in these Specifications, or not less than 6-inches. Bedding for process piping shall

be as specified in Section 15000 - Basic Mechanical Requirements, or as shown on the Drawings.

G. The bottom of all excavations for structures and pipes shall be examined by the Engineer and/or materials testing consultant for bearing value and the presence of unsuitable material. If, in the opinion of the Engineer and/or materials testing consultant, additional excavation is required due to the low bearing value of the subgrade material, or if the in-place soils are soft, yielding, pumping and wet, the Contractor shall remove such material to the required width and depth and replace it with thoroughly compacted select fill, and/or crushed stone or screened gravel as indicated by the Engineer. Payment for such additional work ordered by the Engineer shall be made as an extra by a Change Order in accordance with the General Conditions and Division 1. No payment will be made for subgrade disturbance caused by inadequate dewatering or improper construction methods.

H. All cuts shall be brought to the grade and cross section shown on the Drawings, or established by the Engineer, prior to final inspection and acceptance by the Engineer.

I. Slides and overbreaks which occur due to negligence, carelessness or improper construction techniques on the part of the Contractor shall be removed and disposed of by the Contractor as indicated by the Engineer at no additional cost to the Owner. If grading operations are suspended for any reason whatsoever, partially completed cut and fill slopes shall be brought to the required slope and the work of seeding and mulching or other required erosion and sedimentation control operations shall be performed.

J. Where the excavation exposes sludge, sludge contaminated soil or other odorous materials, the Contractor shall cover such material at the end of each workday with a minimum of 6-inches and a maximum of 24-inches of clean fill. The work shall be an odor abatement measure and the material shall be placed to the depth deemed satisfactory by the Engineer for this purpose.

3.03 EXCAVATION SUPPORT

A. The Contractor shall furnish, place, and maintain such excavation support which may be required to support sides of excavation or to protect pipes and structures from possible damage and to provide safe working conditions. If the Engineer is of the opinion that at any point sufficient or proper supports have not been provided, he may order additional supports put in at the expense of the Contractor. The Contractor shall be responsible for the adequacy of all supports used and for all damage resulting from failure of support system or from placing, maintaining and removing it.

B. Selection of and design of any proposed excavation support systems is exclusively the responsibility of the Contractor. Contractor shall submit drawings and calculations on proposed systems sealed by a Professional Engineer currently registered in the State of Florida.

C. The Contractor shall exercise caution in the installation and removal of supports to insure that excessive or unusual loadings are not transmitted to any new or existing structure. The Contractor shall promptly repair at his expense any and all damage that can be reasonably attributed to installation or removal of excavation support system.

D. Contractor shall monitor movement in the excavation support systems as well as movement at adjacent structures, utilities and roadways near excavation supports. Contractor shall submit a monitoring plan developed by the excavation support design engineer. All pre-construction condition assessment and documentation of adjacent structures on-site and off-site shall be performed by the Contractor. If any sign of distress such as cracking or movement occurs in any adjacent structure, utility or roadway during installation of supports, subsequent excavation, service period of supports, subsequent backfill and construction, or removal of supports, Engineer shall be notified immediately. Contractor shall be exclusively responsible for repair of any damage to any roadway, structure, utility, pipes, etc. both on-site and off-site, as a result of his operations.

E. All excavation supports shall be removed upon completion of the work except as indicated herein. The Engineer may permit supports to be left in place at the request and expense of the Contractor. The Engineer may order certain supports left permanently in place in addition to that required by the Contract. The cost of the materials so ordered left in place, less a reasonable amount for the eliminated expense of the removal work omitted, will be paid as an extra by a Change Order in accordance with the General Conditions and Division 1. Any excavation supports left in place shall be cut off at least two (2) feet below the finished ground surface or as directed by the Engineer.

3.04 PROTECTION OF SUBGRADE

A. To minimize the disturbance of bearing materials and provide a firm foundation, the Contractor shall comply with the following requirements:

1. Use of heavy rubber-tired construction equipment shall not be permitted on the final subgrade unless it can be demonstrated that drawdown of groundwater throughout the entire area of the structure is at least 3 feet below the bottom of the excavation (subgrade). Even then, the use of such equipment shall be prohibited should subgrade disturbance result from concentrated wheel loads.

2. Subgrade soils disturbed through the operations of the Contractor shall be excavated and replaced with compacted select fill or crushed stone at the Contractor's expense as indicated by the Engineer.

3. The Contractor shall provide positive protection against penetration of frost into materials below the bearing level during work in winter months. This protection can consist of a temporary blanket of straw or salt hay covered with a plastic membrane or other acceptable means.

3.05 PROOFROLLING

A. The subgrade of all structures and all areas that will support pavements or select fill shall be proofrolled. After stripping of topsoil, excavation to subgrade and prior to placement of fills, the exposed subgrade shall be carefully inspected by probing and testing as needed. Any topsoil or other organic material still in place, frozen, wet, soft, or loose soil, and other undesirable materials shall be removed. The exposed subgrade shall be proofrolled with a heavily loaded tandem-wheeled dump truck to check for pockets of soft material hidden beneath a thin crust of better soil. Any unsuitable materials thus exposed shall be removed and replaced with an approved compacted material.

3.06 DEWATERING

A. The Contractor shall do all dewatering as required for the completion of the work. Procedures for dewatering proposed by the Contractor shall be submitted to the Engineer for review prior to any earthwork operations. All water removed by dewatering operations shall be disposed of in accordance with the Florida Erosion and Sediment Control Designer and Reviewer Manual.

B. The dewatering system shall be of sufficient size and capacity as required to control groundwater or seepage to permit proper excavation operations, embankment construction and reconstruction, subgrade preparation, and to allow concrete to be placed in a dry condition. The system shall include a sump system or other equipment, appurtenances and other related earthwork necessary for the required control of water. The Contractor shall drawdown groundwater to at least 3 feet below the bottom of excavations (subgrade) at all times in order to maintain a dry and undisturbed condition.

C. The Contractor shall control, by acceptable means, all water regardless of source. Water shall be controlled and its disposal provided for at each berm, structure, etc. The entire periphery of the excavation areas shall be ditched and diked to prevent water from entering the excavation. The Contractor shall be fully responsible for disposal of the water and shall provide all necessary means at no additional expense to the Owner. The Contractor shall be solely responsible for proper design, installation, proper operation, maintenance, and any failure of any component of the system.

D. The Contractor shall be responsible for and shall repair without cost to the Owner, any damage to work in place and the excavation, including damage to the bottom due to heave and including removal of material and pumping out of the excavated area. The Contractor shall be responsible for damages to any other area or structure caused by his failure to maintain and operate the dewatering system proposed and installed by the Contractor.

E. The Contractor shall take all the steps that he considers necessary to familiarize himself with the surface and subsurface site conditions, and shall obtain the data that is required to analyze the water and soil environment at the site and to assure that the materials used for the dewatering systems will not erode, deteriorate, or clog to the extent that the dewatering systems will not perform properly during the period of dewatering. Copies of logs of borings and laboratory test results are available to the Contractor. This data is furnished for information only, and it is expressly understood that the Owner and Engineer will not be held responsible for any interpretations or conclusions drawn therefrom by the Contractor.

F. Prior to the execution of the work, the Contractor, Owner and Engineer shall jointly survey the condition of adjoining structures. Photographs and records shall be made of any prior settlement or cracking of structures, pavements, and the like, that may become the subject of possible damage claims.

3.07 EMBANKMENTS

A. The Contractor shall perform the construction of embankments in such a manner that cut and fill slopes will be completed to final slopes and grade in a continuous operation. The operation of removing excavation material from any cut and the placement of embankment

in any fill shall be a continuous operation to completion unless otherwise permitted by the Engineer.

B. Surfaces upon which embankments are to be constructed shall be stripped of topsoil, organic material, rubbish and other extraneous materials. After stripping and prior to placing embankment material, the Contractor shall compact the top 12-inches of in place soil as specified under Paragraph 3.09, COMPACTION.

C. Any soft or unsuitable materials revealed before or during the in place compaction shall be removed as indicated by the Engineer and/or materials testing consultant and replaced with select fill.

D. Ground surfaces on which embankment is to be placed, shall be scarified or stepped in a manner which will permit bonding of the embankment with the existing surface. The embankment soils shall be as specified under Part 2 - Products, and shall be deposited and spread in successive, uniform, approximately horizontal layers not exceeding 8-inches in compacted depth for the full width of the cross section, and shall be kept approximately level by the use of effective spreading equipment. Hauling shall be distributed over the full width of the embankment, and in no case will deep ruts be allowed to form during the construction of the embankment. The embankment shall be properly drained at all times. Each layer of the embankment shall be thoroughly compacted to the density specified under Paragraph 3.09, COMPACTION.

E. The embankment or fill material in the layers shall be of the proper moisture content before rolling to obtain the prescribed compaction. Wetting or drying of the material and manipulation when necessary to secure a uniform moisture content throughout the layer shall be required. Should the material be too wet to permit proper compaction or rolling, all work on all portions of the embankment thus affected shall be delayed until the material has dried to the required moisture content. Samples of all embankment materials for testing, both before and after placement and compaction, will be taken at frequent intervals. From these tests, corrections, adjustments, and modifications of methods, materials, and moisture content will be made to construct the embankment.

F. Where embankments are to be placed and compacted on hillsides, or when new embankment is to be compacted against embankments, or when embankment is built in part widths, the slopes that are steeper than 4:1 shall be loosened or plowed to a minimum depth of 6 inches or, if in the opinion of the Engineer, the nature of the ground is such that greater precautions should be taken to bind the fill to the original ground then benches shall be cut in the existing ground as indicated by Engineer.

G. When rock and other embankment material are excavated at approximately the same time, the rock shall be incorporated into the outer portions of the embankments and the other material which meets the requirements for select fill shall be incorporated into the formation of the embankments. Stones or fragmentary rock larger than 4-inches in their greatest dimension will not be allowed within the top 6-inches of the final grade. Stones, fragmentary rock, or boulders larger than 12-inches in their greatest dimension will not be allowed in any portions of embankments and shall be disposed of by the Contractor as indicated by the Engineer. When rock fragments or stone are used in embankments, the material shall be brought up in layers as specified or directed and every effort shall be exerted to fill the voids

with finer material to form a dense, compact mass which meets the densities specified for embankment compaction.

3.08 BACKFILLING

A. All structures and pipes shall be backfilled with the type of materials shown on the Drawings and specified herein. Select fill shall be deposited in successive, uniform, approximately horizontal layers not exceeding 8-inches in compacted depth for the full width. Stones or fragmentary rock larger than 4-inches in their greatest dimension will not be allowed within the top 6-inches of the ground nor within 6 inches of pipes. No stone or fragmentary rock larger than 12-inches in their greatest dimension will be allowed for any portion of backfill. Compaction shall be in accordance with the requirements of Paragraph 3.09, COMPACTION.

B. Where excavation support is used, the Contractor shall take all reasonable measures to prevent loss of support beneath and adjacent to pipes and existing structures when supports are removed. If significant volumes of soil cannot be prevented from clinging to the extracted supports, the voids shall be continuously backfilled as rapidly as possible. The Contractor shall thereafter limit the depth below subgrade that supports will be installed in similar soil conditions or employ other appropriate means to prevent loss of support.

3.09 COMPACTION

A. The Contractor shall compact embankments, backfill, crushed stone, aggregate base, and in place subgrade in accordance with the requirements of this Section. The densities specified herein refer to percentages of maximum density as determined by the noted test methods. Compaction of materials on the project shall be in accordance with the following schedule:

	Density % Std. Proctor (D698)	Density % Mod. Proctor (D1557)	Max. Lift Thickness as Compacted Inches
Embankments Beneath Structures*	98	95	8
Other Embankments	95	92	8
Backfill Around Structures	95	92	8
Backfill in Pipe Trenches	95	92	8
Crushed Stone Beneath Structures	**	**	12
Select Sand	--	98	8
Aggregate Base Course (ABC) Beneath Pavements and Structures	--	98	8
Crushed Stone Backfill	**	**	12
Crushed Stone Pipe Bedding	**	**	12
In place Subgrade Beneath Structures	98	95	Top 12-inches

* Embankments beneath structures shall be considered to include a zone 10 feet out from the foundation of the structure extending down to the natural ground on a 45 degree slope.

** The aggregate shall be compacted to a degree acceptable to the Engineer by use of a vibratory compactor and/or crawler tractor.

B. Field density tests will be made by the materials testing consultant to determine if the specified densities have been achieved, and these tests shall be the basis for accepting or rejecting the compaction. In-place density tests will be performed in accordance with ASTM D 2922. The Engineer in conjunction with the materials testing consultant will be the judge as to which test method will be the most appropriate. Failure to achieve the specified densities shall require the Contractor to re-compact the material or remove it as required. The Contractor shall, if necessary, increase his compactive effort by increasing the number of passes, using heavier or more suitable compaction equipment, or by reducing the thickness of the layers. The Contractor shall adjust the moisture contents of the soils to bring them within the optimum range by drying them or adding water as required.

C. Testing will be performed as frequently as deemed necessary by the Engineer and/or materials testing consultant. As a minimum, one in-place density test shall be performed on each lift for 1000 cubic yards of embankment placed and 500 cubic yards of backfill placed or one test performed each day for either. Testing will also be required around all structures placed by the Contractor.

3.10 REMOVAL OF EXCESS AND UNSUITABLE MATERIALS

A. The Contractor shall remove and dispose of off-site all unsuitable materials. Within thirty (30) consecutive days after Notice to Proceed, the Contractor shall submit to the Engineer for review all required permits and a list of disposal sites for the unsuitable materials. If the disposal site is located on private property, the submittal shall also include written permission from the owner of record.

B. All unsuitable materials shall be disposed of in locations and under conditions that comply with federal, state and local laws and regulations.

C. The Contractor shall obtain an off-site disposal area prior to beginning demolition or excavation operations.

D. All excess and unsuitable materials shall be hauled in trucks of sufficient capacity and tight construction to prevent spillage. Trucks shall be covered to prevent the propagation of dust.

E. When all excess and unsuitable material disposal operations are completed, the Contractor shall leave the disposal sites in a condition acceptable to the Owner and Owner(s) of the disposal site(s).

3.11 BORROW EXCAVATION

A. Description

The work covered by this section consists of the excavation of approved material from

borrow sources and the hauling and utilization of such material as required on the Drawings or directed by the Engineer. It shall also include the removing, stockpiling, and replacement of topsoil on the borrow source; the satisfactory disposition of material from the borrow source which is not suitable for use; and the satisfactory restoration of the borrow source and haul roads to an acceptable condition upon completion of the work.

Borrow excavation shall not be used before all available suitable unclassified excavation has been used for backfill and incorporated into the embankments.

B. Coordination with Seeding Operations

The Contractor shall coordinate the work covered by this section with the construction of embankments so that the requirements of Section 02200 are met.

C. Materials

All material shall meet the requirements of Division 2 shown below:

Borrow Material .....Section 02200, Subsection 2.01 - Select Fill

D. Construction Methods

1. General

The surface of the borrow area shall be thoroughly cleared and grubbed and cleaned of all unsuitable material including all organics, topsoil, etc., before beginning the excavation. Disposal of material resulting from clearing and grubbing shall be in accordance with Section 02100.

Each borrow operation shall not be allowed to accumulate exposed, erodible slope area in excess of 1 acre at any one given time without the Contractor's beginning permanent seeding and mulching of the borrow source or other erosion control measures as may be approved by the Engineer.

The topsoil shall be removed and stockpiled at locations that will not interfere with the borrow operations and that meet the approval of the Engineer. Temporary erosion control measures shall be installed as may be necessary to prevent the erosion of the stockpile material. Once all borrow has been removed from the source or portion thereof, the stockpiled topsoil shall be spread uniformly over the source.

Where it is necessary to haul borrow material over existing roads, the Contractor shall use all necessary precautions to prevent damage to the existing roads. The Contractor shall also conduct his hauling operations in such a manner as to not interfere with the normal flow of traffic and shall keep the traffic lanes free from spillage at all times.

2. Owner Furnished Sources

Where borrow sources are furnished by the Owner the location of such sources will

be as designated on the Drawings or as directed by the Engineer.

The Owner will furnish the necessary haul road right-of-way at locations designated by the Engineer. All haul roads required shall be built, maintained, and when directed by the Engineer, obliterated, at no cost to the Owner. Where the haul road is to be reclaimed for cultivation the Contractor shall plow or scarify the area to a minimum depth of 8 inches.

The borrow sources shall be left in a neat and presentable condition after use. All slopes shall be smoothed, rounded, and constructed not steeper than 3:1. Where the source is to be reclaimed for cultivation the source shall be plowed or scarified to a minimum depth of 8 inches, disc harrowed, and terraces constructed. The source shall be graded to drain such that no water will collect or stand and a functioning drainage system shall be provided.

All sources shall be seeded and mulched in accordance with Section 02910.

3. Contractor Furnished Sources

Prior to the approval of any off-site borrow source(s) developed for use on this project, the Contractor shall obtain certification from the State Historic Preservation Officer of the State Department of Cultural Resources certifying that the removal of the borrow material from the borrow source(s) will have no effect on any known district, site building, structure, or object that is included or eligible for inclusion in the National Register of Historic Places. A copy of this certification shall be furnished to the Engineer prior to performing any work on the proposed borrow source.

The approval of borrow sources furnished by the Contractor shall be subject to the following conditions:

a. The Contractor shall be responsible for acquiring the right to take the material and any rights of access that may be necessary; for locating and developing the source; and any clearing and grubbing and drainage ditches necessary.

   Such right shall be in writing and shall include an agreement with the Owner that the borrow source may be dressed, shaped, seeded, mulched, and drained as required by these Specifications after all borrow has been removed.

b. Except where borrow is to be obtained from a commercial source, the Contractor and the property owner shall jointly submit a borrow source development, use, and reclamation plan to the Engineer for his approval prior to engaging in any land disturbing activity on the proposed source other than material sampling that may be necessary. The Contractor's plan shall address the following:

   (1) Drainage

   The source shall be graded to drain such that no water will collect or

stand and a functioning drainage system shall be provided. If drainage is not practical, and the source is to serve as a pond, the minimum average depth below the water table shall be 4 feet or the source graded so as to create wetlands as appropriate.

(2) Slopes

The source shall be dressed and shaped in a continuous manner to contours which are comparable to and blend in with the adjacent topography, but in no case will slopes steeper than 3:1 be permitted.

(3) Erosion Control

The plan shall address the temporary and permanent measures that the Contractor intends to employ during use of the source and as a part of the reclamation. The Contractor's plan shall provide for the use of staged permanent seeding and mulching on a continual basis while the source is in use and the immediate total reclamation of the source when no longer needed.

4. Maintenance

During construction and until final acceptance the Contractor shall use any methods approved by the Engineer which are necessary to maintain the work covered by this section so that the work will not contribute to excessive soil erosion.

- END OF SECTION -

SECTION 02222

EXCAVATION AND BACKFILL FOR UTILITIES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall excavate, grade and backfill as required for underground piping systems and appurtenances as shown on the Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Division 1 – General Requirements

B. Division 3 – Concrete

C. Section 15000 – Piping, General

D. Section 15995 – Pipeline Testing and Disinfection

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARD

A. Codes: All codes, as referenced herein, are specified in Section 01090 - Reference Standards.

B. Commercial Standards:

ASTM D 422	Method for Particle-Size Analysis of Soils.
ASTM D 698	Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-lb (2.49-kg) Rammer and 12-in (304.8-mm) Drop.
ASTM D 1556	Test Method for Density of Soil in Place by the Sand-Cone Method.
ASTM D 1557	Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in (457-mm) Drop.

ASTM D 2419	Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
ASTM D 2922	Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

1.03 SUBMITTALS

A. General: Submit information and samples to the ENGINEER for review as specified herein in accordance with Section 01300 entitled "Submittals".

B. Dewatering: The CONTRACTOR shall submit to the ENGINEER his proposed methods of handling trench water and the locations at which the water will be disposed. Methods shall be acceptable to the ENGINEER and meet all Federal, State, and local regulatory requirements before starting the excavation. The CONTRACTOR shall procure such permits at his expense and submit copies to the ENGINEER before commencing the work.

C. Bedding and Backfill Materials: The CONTRACTOR shall notify the ENGINEER of the off-site sources of bedding and backfill materials, and submit to the ENGINEER the testing results of a representative sample weighing approximately 50 pounds. The sample shall be delivered to a location or site determined acceptable by the ENGINEER. All fees associated with testing shall be paid for by the CONTRACTOR.

D. Sheeting System: Drawings of the sheeting system and design computations shall be submitted to the ENGINEER; however, the review of these drawings shall in no way relieve the CONTRACTOR of the responsibility to provide a safe and satisfactory sheeting and shoring system. Sheeting and shoring shall be designed by the CONTRACTOR, and the proposed design shall be sealed by a Professional Engineer registered in the State of Florida. If the ENGINEER is of the opinion that, at any point, sufficient or proper supports have not been provided, he may order additional supports put in at the CONTRACTOR’s expense.

1.04 QUALITY CONTROL

A. An independent testing laboratory will be retained by the CONTRACTOR and approved by the ENGINEER/OWNER to do appropriate testing as described in Section 01400 entitled “Quality Control”. The CONTRACTOR shall schedule his work so as to permit a reasonable time for testing before placing succeeding lifts and shall keep the laboratory informed of his progress. A minimum of 48 hours of notice shall be provided to the testing laboratory to mobilize its activities.

1.06 SUBSURFACE INFORMATION

A. The CONTRACTOR shall be responsible for anticipating groundwater conditions and shall provide positive control measures as required. Such measures shall ensure stability of excavations, groundwater pressure control, prevention of tanks, pipes, and other structures from being lifted by hydrostatic pressures, and avoiding the disturbance of subgrade bearing materials.

B. The OWNER and/or the ENGINEER will not assume responsibility for subsoil quality or conditions. The CONTRACTOR shall examine the site and review available geotechnical information and undertake his own subsurface investigation prior to submitting his bid, taking into consideration all conditions that may affect his Work. CONTRACTOR is to understand that there are existing lime slurry deposits throughout the site from past water plant operations. All such material, if encountered, is to be considered non-suitable for backfill and must be removed and disposed of in a manner agreeable to the OWNER.

1.07 TRENCH SAFETY ACT COMPLIANCE

A. The CONTRACTOR, by signing and executing the contract is, in writing, assuring that he will perform any trench excavation in accordance with the Florida Trench Safety Act, Section 553.60 et. seq.. The CONTRACTOR has further identified the separate item(s) of cost of compliance with the applicable trench safety standards as well as the method of compliance as noted in the "Bid Forms" Section of the Contract front-end documents.

B. The CONTRACTOR acknowledges that this cost is included in the applicable items of the Proposal and Contract and in the Grand Total Bid and Contract Price.

C. The CONTRACTOR is, and the OWNER and ENGINEER are not, responsible to review or assess the CONTRACTOR’s safety precautions, programs or costs, or the means, methods, techniques or technique adequacy, reasonableness of cost, sequences or procedures of any safety precaution, program or cost, including but not limited to, compliance with any and all requirements of Florida Statute Section 553.60 et. seq. cited as the "Trench Safety Act". The CONTRACTOR is, and the OWNER and ENGINEER are not, responsible to determine if any safety or safety related standards apply to the project, including, but not limited to, the "Trench Safety Act".

1.08 PROTECTION OF PROPERTY AND STRUCTURES

A. The CONTRACTOR shall, at his own expense, sustain in place and protect from direct or indirect injury, all pipes, poles, conduits, walls, buildings, and all other structures, utilities, and property in the vicinity of its Work. Such sustaining shall be done by the CONTRACTOR. The CONTRACTOR shall take all risks attending the presence or proximity of pipes, poles, conduits, walls, buildings, and all other structures, utilities, and his Work. The CONTRACTOR shall be responsible for all damage, and assume all expenses, for direct or indirect injury and damage, caused by his Work, to any such

pipe, structures, etc., or to any person or property, by reason of injury to them, whether or not such structures, etc., are shown on the Drawings.

B. Barriers shall be placed at each end of all excavations and at such places as may be necessary along excavations to warn all pedestrian and vehicular traffic of such excavations. Barricades with flashing lights shall also be placed along an excavation, from sunset each day to sunrise of the next day, until such excavation is entirely refilled, compacted, and paved. All excavations shall be barricaded where required to meet OSHA, local and Federal Code requirements, in such a manner to prevent persons from falling or walking into any excavation within the site fenced property limits.

PART 2 – PRODUCTS

2.01 BEDDING MATERIAL

A. Bedding materials shall be furnished from acceptable off-site sources. The CONTRACTOR shall notify the ENGINEER of the sources of each material at least ten (10) calendar days prior to the anticipated use of the materials.

B. Screened gravel shall be used as bedding material for small diameter pipe (less than 24 inches). Screened gravel shall also be used as bedding material for fiberglass, PVC, HDPE or other plastic pipe when installation is in the wet. Screened gravel shall consist of hard, durable particles of proper size and graduation, and shall be free from organic material, wood, trash, sand, loam, clay, excess fines, and other deleterious materials. The gravel shall be graded within the following limits:

Sieve Size	Percent Finer by Weight
1 inch	100
3/4 inch	99
1/2 inch	65
No. 4	2

C. Crushed stone shall be used for bedding of 24-inch and larger diameter pipe. Crushed stone shall also be used when the trench is within the water table for all types of piping except fiberglass, PVC, HDPE or other plastic pipe. Crushed stone shall consist of hard, durable, subangular particles of proper size and gradation, without clay, fines, and other deleterious materials. The stone shall be graded within the following limits:

Sieve Size	Percent Finer by Weight
5/8 inch	100
1/2 inch	40 – 100
3/8 inch	15 - 45
No. 10	0 – 5

E. Sand shall be used for bedding PVC, fiberglass, HDPE and other plastic pipe when installed under dry trench conditions. Sand shall be graded sand with 100 percent passing a 3/8-inch sieve and not more than 5 percent passing a No. 200 sieve.

2.02 SELECT BACKFILL

A. Select Backfill: It is the intent of these specifications to obtain clean sandy material passing through a 3/4-inch sieve as select backfill material for utility and structural applications.

B. At locations where subsurface preparations for structures have been performed under this or other previous construction contracts, clean excavated material (structural fill) may be used as select backfill. Any excess fill shall be disposed off-site by the CONTRACTOR.

2.03 GENERAL BACKFILL

A. All other backfill (for grading applications) shall be placed above the select backfill and shall pass through a 6-inch ring. General backfill shall contain no more than 10 percent organics. General backfill used under roadways shall be compatible with the materials and compaction specified under the Section 02510 entitled “Asphaltic Concrete Pavement”.

PART 3 – EXECUTION

3.01 EXCAVATION

A. The CONTRACTOR shall perform all excavation of every description and of whatever substance encountered, to the dimensions, grades and depths shown on the Drawings, or as required for a proper installation. All excavations shall be made by open cut and in accordance with the Trench Safety Act. All existing utilities, such as pipes, poles and structures, shall be carefully located, supported and protected from injury; in case of damage, and they shall be restored at the CONTRACTOR’s expense.

B. Pipe trenches for piping shall be excavated to a width within the limits of the top of the pipe and the trench bottom so as to provide a clearance on each side of the pipe barrel, measured to the face of the excavation, or sheeting (if used), of 8 inches to 18 inches as defined on the Drawings. Where the pipe size exceeds 12 inches, the clearance shall be from 12 inches to 18 inches. All pipe trenches shall be excavated to a level where suitable material is reached, a minimum of 8 inches below the pipe barrel or that will allow for a minimum of 36 inches of covering unless otherwise indicated on the Drawings.

C. Ladders or steps shall be provided for and used by workmen to enter and leave trenches. All ladders or steps shall meet OSHA and Florida Safety Act regulatory requirements.

D. Excavated unsuitable material shall be removed from the site and disposed by the CONTRACTOR. Materials removed from the trenches shall be stored in such a manner that will not interfere unduly with traffic on public roadways and sidewalks and shall not be placed on private property. In congested areas, such materials that cannot be stored adjacent to the trench or used immediately as backfill shall be removed to other convenient places of storage acceptable to the OWNER at the CONTRACTOR's expense.

E. Excavated material that is suitable for use as backfill shall be used in areas where sufficient material is not available from the excavation. Suitable material in excess of backfill requirements shall be disposed offsite at the CONTRACTOR's expense.

3.02 SHEETING AND BRACING

A. The CONTRACTOR shall furnish, place and maintain sheeting and bracing to support sides of the excavation as necessary to provide safe working conditions in accordance with OSHA requirements, and to protect pipes, structures and other work from possible damage. Where wood sheeting or certain designs of steel sheeting are used, the sheeting shall be cut off at a level of two (2) feet above the top of the installed pipe, and that portion below the level shall be left in place. If interlocking steel sheeting is used, it may be removed providing removal can be accomplished without disturbing the bedding, pipe or alignment of the pipe. Any damage to the pipe bedding, pipe or alignment of the constructed utility caused by the removal of sheeting shall be cause for rejection of the affected portion of the work. The OWNER may permit sheeting to be left in place at the request and expense of the CONTRACTOR, or the OWNER may order him in writing to leave sheeting in place, to prevent damage to structures or property. Payment for sheeting ordered to remain in place shall be paid for at a negotiated price.

B. If the ENGINEER is of the opinion that, at any point, sufficient or proper support have not been provided, he may order additional supports put in at the CONTRACTOR's expense. The CONTRACTOR shall be responsible for the adequacy of all sheeting used and for all damage resulting from sheeting and bracing failure or from placing, maintaining and removing it.

3.03 METHOD OF CONSTRUCTION IN THE WET

A. The requirements set forth in other sections of these Specifications shall establish required standards of construction quality for this work. Use of this method of construction described hereinafter shall in no way be construed as relieving the CONTRACTOR of the work. No additional payment will be made to the CONTRACTOR for excavation, backfill, sheeting or any cost incurred for work or materials, or any other costs incurred as a result of the use of this method of construction.

B. Subject to all the requirements stated herein, including written acceptance by the ENGINEER, construction will be permitted in accordance with the following Specifications. All requirements of these Specifications shall apply to this construction unless otherwise specifically modified herein.

C. Pipe Bedding: Pipe bedding shall be placed from 6 inches below the outside bottom of the proposed pipe barrel up to the level of the lower one-third of the pipe barrel. The bedding material shall be screened gravel as specified in Article 2.01, "Bedding Materials". Limerock screenings, sand or other fine organic material shall not be used.

D. The bedding material shall be placed and then be shaped to receive the pipe at the intended elevation. Bedding shall be provided under the branch of all fittings to furnish adequate support and bearing under the fitting.

E. Backfill: After the pipe is installed, backfilling shall proceed in accordance with the provisions of Article 3.07, "Backfill" and Article 3.08, "Compaction and Densities". Select backfill material shall be used to backfill around the pipe and to a level one (1) foot above the crown of the pipe. Under no circumstances will material other than select backfill or specified pipe bedding material be considered satisfactory for this purpose.

F. If this method of construction is used, all backfill material, including specified pipe bedding material, shall be carefully lifted into the trench and not released to fall freely therein until the bucket or container is at or just above water level. Under no circumstances will backfill material be dumped or pushed into the trenches containing water. Below existing water level, the backfill material shall be carefully rammed into place in uniform layers, of equal depth, on each side of the pipe, up to the water level. Above the water level, backfill material shall be placed and compacted for normal backfill as previously specified.

3.04 REMOVAL OF WATER

A. The CONTRACTOR shall provide pumps, and other appurtenant equipment necessary to remove and maintain water at such a level as to permit construction in a dry condition. The CONTRACTOR shall continue dewatering operations until backfilling has progressed to a sufficient depth over the pipe to prevent flotation or movement of the pipe in the trench or so that it is above the water table. If at any point during the dewatering operation it is determined that fine material is being removed from the excavation sidewalls, the dewatering operation shall be stopped. If any of the subgrade or underlying material is disturbed by movement of groundwater, surface water, or any other reason, it shall be replaced at the CONTRACTOR's expense with crushed stone or gravel.

B. The CONTRACTOR shall use dewatering systems that include automatic starting devices, and standby pumps that will ensure continuous dewatering in the event of an outage of one or more pumps.

C. Disposal: Water from the trenches and excavation shall be disposed in such a manner as will not cause injury to public health, to public or private property, to the work completed or in progress, to the surface of the streets, cause any interference with the use of the same by the public, or cause pollution of any waterway or stream. The CONTRACTOR shall submit his proposed methods of handling trench water and locations at which the water will be disposed to the ENGINEER for review and shall receive acceptance before starting the excavation. Disposal to any surface water body will require silt screens to prevent any degradation in the water body. The CONTRACTOR shall have responsibility for acquiring all necessary permits for disposal.

3.05 TRENCH STABILIZATION

A. No claim for extra or additional payment will be considered for costs incurred in the stabilization of trench bottoms which are rendered soft or unstable as a result of construction methods, such as improper or inadequate sheeting, dewatering or other causes. In no event shall pipe be installed when such conditions exist, and the CONTRACTOR shall correct such conditions so as to provide proper bedding or foundations for the proposed installation, at no additional cost to the OWNER, before placing the pipe or structures.

3.06 PIPE BEDDING IN DRY TRENCHES

A. Pipe trenches shall be excavated as described in Article 3.01, “Excavation”. The resulting excavation shall be backfilled with acceptable pipe bedding material, up to the level of the centerline of the proposed pipe barrel. This backfill shall be tamped and compacted to provide a proper bedding for the pipe and shall then be shaped to receive the pipe. Bedding shall be provided under the branch of all fittings to furnish adequate support and bearing under the fitting.

B. Any over-excavation below the levels required for installation of the pipe shall be backfilled with acceptable bedding material, tamped, compacted and shaped to provide proper support for the proposed pipe, at the CONTRACTOR’s expense.

3.07 BACKFILL

A. The CONTRACTOR shall not backfill trenches until the piping has been inspected. After backfilling and compaction, pipe shall be tested in accordance with Section 15995 entitled “Pipeline Testing and Disinfection”.

B. Pipelines: Pipeline trenches shall be backfilled to a level 12 inches above the top of the pipe with select backfill. When placed in the dry, such material shall be placed in 6-inch

lifts, each compacted to the densities specified in Article 3.08, “Compaction and Densities”. Only hand operated mechanical compacting equipment shall be used within six inches of the installed pipe.

C. After the select backfill has been placed as specified above, and after all excess water has completely drained from the trench, general backfilling of the remainder of the trench may proceed. General backfill shall be placed in horizontal layers, the depth of which shall not exceed the ability of the compaction equipment employed, and in no event shall exceed a depth of 12 inches. Each layer shall be moistened, tamped, puddled, rolled or compacted to the densities specified in Article 3.08, Compaction and Densities”.

D. Manholes and Vaults: Any excavation below the levels required for the proper construction of manholes or vaults shall be filled with Class B concrete. The use of earth, rock, sand or other materials for this purpose will not be permitted.

3.08 COMPACTION AND DENSITIES

A. Compaction of backfill shall be 98 percent of the maximum density where the trench is located under structures or paved areas, and 95 percent of the maximum density elsewhere. Methods of control and testing of backfill construction are:

1. Maximum density of the material in trenches shall be determined by ASTM D 1557.
2. Field density of the backfill material in place shall be determined by ASTM D 1556 or ASTM D 2922.

B. Testing: Laboratory and field density tests, which in the opinion of the ENGINEER are necessary to establish compliance with the compaction requirements of these Specifications, shall be ordered by the ENGINEER. The CONTRACTOR shall coordinate and cooperate with the testing laboratory. The testing program will be implemented by the ENGINEER to establish depths and locations of tests. Modifications to the program will be made as job conditions change.

C. Trench backfill which does not comply with the specified densities, as indicated by such tests, shall be reworked and recompacted until the required compaction is secured, at no additional cost to the OWNER. The costs for retesting such Work shall be paid for by the CONTRACTOR.

3.09 ADDITIONAL EXCAVATION AND BACKFILL

A. Where organic material, such as roots, muck, or other vegetative matter, or other material which, in the opinion of the ENGINEER, will result in unsatisfactory foundation

conditions, is encountered below the level of the proposed pipe bedding material, it shall be removed to a depth of two (2) feet below the outside bottom of the pipe or to a greater depths as directed by the ENGINEER and removed from the site. Sheeting shall be installed if necessary to maintain pipe trenches within the limits identified by the ENGINEER. The resulting excavation shall be backfilled with suitable backfill material, placed in 12-inch layers, tamped and compacted up to the level of the bottom of the proposed pipe bedding material. Sufficient compaction of this material shall be performed to protect the proposed pipe against settlement. Lean concrete may be used in lieu of backfill when pipe installation is in the wet or at the CONTRACTOR's option. Construction shall then proceed in accordance with the provisions of Article 3.05, "Trench Stabilization".

B. Additional excavation (more than two feet below the pipe) shall be performed when ordered by the ENGINEER. Where organic or other material is encountered in the excavation, the CONTRACTOR shall bring the condition to the attention of the ENGINEER and obtain his determination as to whether or not the material will require removal, prior to preparing the pipe bedding. The excavation of material up to a depth of two (2) feet below the outside bottom of incidental items of construction and the Work shall be done at no additional cost to the OWNER. Where ordered by the ENGINEER, excavation greater than two (2) feet below the pipe, backfill and additional sheeting, will be compensated by the OWNER.

3.10 RESTORATION OF EXISTING SURFACES

A. Restore all grassed and stone cover areas disturbed by the trenching operations or impact of heavy equipment to original conditions in accordance with the General Requirements.

B. Restore all asphaltic concrete pavement areas disturbed by the trenching operations or impact of heavy equipment by providing a full overlay across the roadway in the area of the damage.

C. Restore all concrete pavement and sidewalks disturbed by the trenching operations or impact of heavy equipment by placement of new concrete to the original dimensions and reinforcement back to the nearest joint.

- END OF SECTION -

SECTION 02224

EXCAVATION AND BACKFILL FOR STRUCTURES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. This section consists of excavation, dewatering, if required, backfill and compaction under structures required for a complete installation as shown on the Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 - Submittals

B. Section 02100 - Clearing and Grubbing.

1.03 DEFINITIONS

A. Maximum Density: Maximum weight in pounds per cubic foot of a specific material.

B. Optimum Moisture: Percentage of water in a specific material at maximum density.

1.04 SUBMITTALS

A. The Contractor shall submit information and samples as specified herein to the Engineer for review in accordance with the Section entitled "Submittals".

B. Dewatering

1. The Contractor shall submit his proposed methods of handling groundwater and the locations at which the water will be disposed of. Methods shall be acceptable to the Engineer before starting and excavating. The Contractor shall pay for and procure all necessary permits for dewatering. The CONTRACTOR shall also be responsible for the appropriate handling of all dewatering discharge. Any negative impact caused by dewatering discharge, shall be immediately corrected by the CONTRACTOR at their expense.

2. Plans showing the methods and location of dewatering and discharge. The drawings shall include a sufficient number of detailed sections to clearly illustrate the Scope of Work. The Drawings showing all of the above information, including calculations, shall be prepared by a qualified Professional Engineer registered in the State of Florida, and shall bear its seal and signature. If required by regulatory agencies, a copy of the dewatering permit shall be submitted.

C. Structural Fill Material

1. The Contractor shall notify the Engineer of the off-site sources of structural fill and submit to the Engineer testing results a representative sample weighing approximately 50 lbs. Testing will be at the Contractor's expense

D. Approvals Required

1. Prior to any earthwork, the Contractor shall submit a sieve analysis of the proposed structural fill to Engineer for review and approval.

2. The Contractor shall not place any footing reinforcing until the excavations have been tested for compaction.

3. The Contractor shall apply for and obtain all necessary permits for dewatering. Contractor shall be responsible for all permit fees.

E. Sheeting design calculations and drawings shall be submitted where required. Drawings of sheeting designed by Contractor shall be signed and sealed by a Professional Engineer registered in the State of Florida.

1.05 QUALITY CONTROL

A. An independent testing laboratory will be retained by the Contractor to do appropriate testing as described in Section 01400 entitled "Quality Control". The Contractor shall schedule his Work so as to permit a reasonable time for testing before placing succeeding lifts and shall keep the laboratory informed of his progress.

1.06 JOB CONDITIONS

A. A geotechnical report is included in Attachment A as a reference for information purposes only. The report identifies properties below grade and also offers recommendations for foundation design, primarily for use of the Engineer. The recommendations shall not be construed as requirements of the Contract unless specifically referenced by the Contract Documents.

B. The Owner and/or the Engineer will not assume responsibility for variations of sub-soil quality or conditions at locations other than places shown and at the time the geotechnical investigation was made. The Contractor shall examine the site and review the available geotechnical report or undertake its own subsurface investigation prior to submitting his bid, taking into consideration all conditions that may affect his work.

C. The Contractor shall satisfy himself as to the character and amount of different soil materials, groundwater and the subsurface conditions to be encountered in the work to be performed. Information and data, when furnished, are for the Contractor's general information. However, it is expressly understood that any interpretation or conclusion drawn there from is totally the responsibility of the Contractor. Engineer and Owner assume no liability for the accurateness of the data reported.

D. Locate existing underground utilities in areas of work. Test pits and hand excavation in critical areas will be required prior to initiating work.

E. All existing utilities including piping, electrical conduits, electrical duct banks and telephone cables that are shown on the Contract Documents to be relocated, shall be relocated prior to initiating earthwork. Excavation and backfill for relocation of existing utilities shall conform to the requirements of Section 02222 entitled "Excavation and Backfill for Utilities". The Contractor shall coordinate relocation of utilities with utility companies having jurisdiction in the area. Should unknown or incorrectly identified piping or other utilities be encountered during excavation, the Contractor shall consult the Owner and the Engineer immediately for directions.

F. The Contractor shall cooperate with the Owner and utility companies in keeping respective services and facilities in operation.

1.07 GROUNDWATER

A. The Contractor shall be responsible for anticipating groundwater conditions and shall provide positive control measures as required. Such measures shall ensure construction in the dry, stability of excavations, groundwater pressure control, prevention of tanks, pipes, and other structures from being lifted by hydrostatic pressures, and avoiding the disturbance of subgrade bearing materials.

1.08 PROHIBITION OF BLASTING

A. The use of explosives for excavation Work is strictly prohibited on this project.

1.09 PROTECTION OF PROPERTY AND STRUCTURES

A. The Contractor shall, at his own expense, sustain in place and protect from direct or indirect injury, all pipes, poles, conduits, walls, buildings, and all other structures, utilities, and property in the vicinity of his work. Such sustaining shall be done by the Contractor. The Contractor shall take all risks attending the presence of proximity of pipes, poles, conduits, walls, buildings, and all other structures, utilities, and property in the vicinity of his work. He shall be responsible for all damage, and assume all expenses, for direct or indirect injury and damage, caused by his work, to any such pipe, structures, etc., or to any person or property, by reason of injury to them, whether or not such structures, etc., are shown on the Drawings.

PART 2 -- PRODUCTS

2.01 STRUCTURAL FILL MATERIAL

A. Materials for structural shall be furnished as required from off-site or on-site sources as required. Structural fill material shall be clean sand or sand and rock free from vegetation, organic material, muck, or other deleterious matter. Not more than 10 percent by weight shall pass the No. 200 sieve. All rock shall pass through a 6-inch diameter ring. Broken Portland cement or asphaltic concrete will not be considered an acceptable fill material.

B. Unsuitable Fill Material: Classified as A-2-4, A-2-5, A-2-6, A-2-7, A-4, A-5, A-6, A-7, and A-8 in accordance with AASHTO Designation M 145. Also peat and other highly organic soils.

C. Backfill Material: Backfill against walls shall be suitable material from on-site or off-site sources that does not contain any rock larger than 1/2 inches. There is a stock pile of suitable fill within the plant site which was left from previous construction activities. This material may be used at the CONTRACTOR's option as fill material. All excess fill, either as a result from the CONTRACTOR's activities or whatever material is not used from this stock pile shall be removed from the site and disposed of properly by the CONTRACTOR at no additional cost to the COUNTY.

2.02 CRUSHED STONE

A. Crushed stone placed below foundation slabs shall be hard, durable, subangular particles of proper size and gradation, and shall be free from organic materials, wood, trash, sand, loam, chalk, excess fines and other deleterious materials. Maximum aggregate size shall be 3/4 inches.

PART 3 -- EXECUTION

3.01 CLEARING AND GRUBBING

A. Clear and grub all surface vegetation. Remove all tree stumps, concentration of roots and other deleterious materials. Stockpile usable topsoil for landscaped areas as directed by the Engineer. Clearing and grubbing is specified in Section 02100.

B. Remove unsuitable topsoil and excavated material for site grading from the construction area.

3.02 REMOVAL OF UNSUITABLE MATERIAL

A. Highly organic soils (peat or muck), weak silty materials, asphalt and concrete shall be removed from all foundation areas. In addition, all sandy silt zones shall be completely removed from mat foundation and footing areas. Excavations shall be carried 5-feet outside slab or footing limits or by one foot for each foot excavated below the bearing grade of the mat or footing, whichever is less.

3.03 EXCAVATION

A. All excavation shall be made in such a manner, and to such widths, as will give ample room for properly constructing and inspecting the structures they are to contain. Excavation shall be made in accordance with the details shown on the Drawings, and as specified herein. Attention shall be given to the handling of storm water runoff.

B. Excavated unsuitable material shall be removed from the site and disposed of by the Contractor.

C. Excavated material that is suitable for use as backfill shall be used in areas where sufficient material is not available from the excavation. Suitable material in excess of backfill requirements shall be used in other areas on the site as directed by the Engineer or disposed off-site at no additional cost to the Owner.

D. The Contractor shall ensure that its excavation work does not adversely affect the bearing capacity of the structural subsurface. Also, the Contractor shall proceed with foundation work immediately after excavation work and as expeditiously as possible so as to minimize any potential for subsurface disturbance due to environmental factors, adverse weather, etc. The Contractor shall also take all necessary precautions to protect its work from potential adverse impacts. Where excavated areas are disturbed by subsequent operations or adverse weather, scarify surface, reshape, fill as required and compact to required density.

3.04 UNAUTHORIZED EXCAVATION

A. Excavation Work carried outside of the Work limits required by the Contract Documents shall be at the Contractor's expense, and shall be backfilled by the Contractor at his own expense with suitable material, as directed by the Engineer. Where, in the judgment of the Engineer, such over-excavation requires use of lean concrete or crushed stone, the Contractor, at his expense shall furnish and place such materials.

3.05 SHEETING AND BRACING

A. Walls of the excavation shall be sloped and, if required to protect the safety of workmen, the general public, this or other Work or structure, or excavation walls, the excavation shall be properly sheeted and braced for conditions encountered and OHSA requirements. Excavation for deep structures shall be sufficient to provide a clearance between their outer surfaces and the face of the excavation, sheeting, or bracing, of not less than 3 feet. Materials encountered in the excavation which have a tendency to slough or flow into the excavation, undermine the bank, weaken the overlying strata, or are otherwise rendered unstable by the excavation operation shall be retained by sheeting, stabilization, grouting or other acceptable methods.

B. Sheeting may be removed provided its removal will not jeopardize existing or new pipes or structures. Any sheeting left in place shall be cut-off 2 feet below finish grade, or as directed. The Contractor will not receive extra compensation for sheeting left in place or the cut off Work required.

C. The design of the sheeting arrangement shall be the responsibility of the Contractor.

3.06 REMOVAL OF WATER

A. The Contractor shall provide pumps, well points, and other appurtenant equipment necessary to remove and maintain water at such a level as to permit construction in a dry condition except where authorized tremie concrete construction Work is shown or permitted. The groundwater level shall be controlled so as to permit the placing and curing of concrete and the maintenance of supporting foundations and adjacent Work

and structures. The dewatering system and points of discharge shall be subject to review and acceptance by the Engineer before installation. Dispose of water to any surface water body will require silt screens.

B. The Contractor shall use dewatering systems that include automatic starting devices, and standby pumps that will ensure continuous dewatering in the event of an outage of one or more pumps. He shall be totally responsible for protecting structures from flotation until final acceptance of the Work. The Contractor shall also modify the dewatering system during the course of construction to satisfy faults, legitimate complaints of legal requirements.

C. Groundwater shall be maintained two to three feet below the excavation in order to permit compaction in dry conditions.

3.07 FILL AND COMPACTION

A. Select structural fill material shall be used for all backfilling work. Fills under mats and footing shall be placed in the dry with loose lift thicknesses of 8 inches or less. Each lift of fill and all subgrades under structures shall be compacted to achieve a minimum of 98% modified Proctor maximum dry density in accordance with ASTM D 1557 or ASTM method approved by Engineer. At least one in-place density test will be made in each lift of compacted soil for a minimum every 2,500 square feet of foundation area. The Contractor shall coordinate and cooperate with the testing laboratory as described in Article 1.05. Materials which yield excessively during the compaction shall be undercut and replaced with well-compacted structural fill.

1. For all construction areas in which the foundation level is not greater than 2 feet below natural or existing ground surface.

a. Proof roll the exposed stripped and excavated surface area by means of an approved heavy vibratory roller (Dynapac CA25 or equal) until ten (minimum) passes have been made and a soil density of 98 percent of maximum modified Proctor Density (ASTM D-1557) has been achieved twenty-four inches below the exposed compacted surface. Test compaction as specified. Add water if necessary to bring up moisture to optimum levels. Replace all material if determined to be deleterious in areas that "yield" during the final rolling operation and replace with suitable fill material.

b. Heavy vibratory equipment (Dynapac CA25 or equal) should be used only in areas greater than 75 feet from existing structures. Within 75 feet of any existing structure, non-vibratory compaction equipment such as a heavy rubber-tired front-end loader with a minimum bucket capacity of three (3) cubic yards should be used. The bucket should be kept full during compaction operations to increase weight. A sufficient number of passes should be made within the construction area to compact the in-place soil to a minimum density of 98% (ASTM D-1557) as tested for the depth of two (2) feet below footing bottoms and slabs on-grade.

c. If ground water is within twelve to twenty-four inches from the ground surface, it will be necessary to lower the ground water to permit effective compaction. Lowering of the ground water may be accomplished by excavating four to five feet deep ditches around the construction area and pumping from sumps in the bottom of ditches.

2. For areas in which the foundations will be placed greater than 2 feet below the existing ground surface.

a. Area shall be dewatered as necessary (minimum of 2 feet below the proposed excavation depth), then excavated to the proposed foundation level and compacted by means of small walk-behind double drum roller or similar equipment. Compaction shall continue until a minimum density of 98 percent of Modified Proctor Density has been achieved as tested for a depth of 2 feet below the foundation level. If, after excavation of such areas, the natural soil becomes disturbed, the foundation soils may need to be over excavated by about 1 foot and replaced with clean, dry, fine sands and compacted as described above.

B. Foundation Preparation (Filling, Backfilling and Excavation)

1. Structures below water table: Level the bottom of dewatered excavation. Remove any unsuitable foundation materials and replace with gravel. Place clean gravel to thickness and extension beyond the foundation slab as indicated on plans. Compact gravel to form a stable working surface with hand held compactors. Keep water table to a minimum of 2 feet below gravel.

2. Buildings: After proof rolling of the stripped building area, place approved fill material within the building foundation lines plus a 6 foot margin in lifts of 12-inch maximum loose thickness. Compact each lift to a minimum of 98 percent Modified Proctor density 12 inches below the surface.

3. Excavation for all building footings and structure foundations shall be made through precompacted soils/building pad to design elevations. Bottom of excavation shall be additionally compacted to 98% of Modified Proctor Density 12-inches below the surface by portable vibratory sled type of compactors. Test compaction as specified.

4. Building Slab Backfill: Place fill inside the building foundation walls in lifts of 6-inches maximum loose thickness, each lift compacted with vibratory portable compactors and fill brought to bottom of the slab. Add necessary water to each lift to bring moisture content to optimum levels and compacting to achieve a minimum of 98% of modified Proctor Density 6-inches below the surface.

5. Form monolithic slab beams by excavating from the compacted fill material to grades and lines indicated on the drawings.

6. Place all backfill under the slabs, around utility trenches, mechanical and plumbing pipes, etc., in layers of six inches maximum loose thickness and

compact with portable plate compactors to achieve a minimum of 95% of Modified Proctor density as per ASTM D-1557.

7. Equipment Pads and Slabs on Grade: Cut, fill and compact subgrades for concrete slabs to required grade. Compact top 8-inches of concrete slab subgrade in cut sections and all fill material to a density of not less than 95 percent of its maximum density 12-inches below the surface as determined by ASTM D-1557.

8. Vibratory compaction shall never be done on dry sandy material or when water table is within 24 inches of the surface. Before start of vibratory compaction, the soils should either have natural moisture or applied water to bring the soils to optimum moisture content.

9. Test compaction of all structural fill by a testing lab as specified.

C. Final Grades
1. Final fill grades shall be within 0.1 foot of elevations shown. Where shown on the Drawings surfaces shall be sloped for drainage or other purposes.

D. Backfill Against Structures

1. Backfill against concrete or masonry structure shall not be performed until the Work has been reviewed and backfilling permitted. Backfill against walls shall also be deferred until the structural slab for floors above the top fill line have been placed and attained design strength or earlier at the discretion of the Engineer. Partial backfilling against adequately braced walls may be considered by the Engineer on an individual situation basis. Where walls are to be waterproofed all Work shall be completed and membrane materials dried or cured according to the manufacturers instructions before backfilling.

E. Backfill against tanks and other structures which are to retain liquids shall not be performed until leakage tests are completed and accepted by the Engineer in accordance with Section 02667 entitled "Hydraulic Structures Testing".

F. Well Pointed Areas

1. For fills being placed in confined areas within well pointed areas, the water table shall be lowered and maintained within practical limits in order that as much dry fill material may be placed and compacted as possible.

G. Suitable excavated soils shall be replaced as backfill in uniform lifts not to exceed 12 inches loose and compacted with the equipment and to the degree as specified above. Suitable materials are sands or slightly silty sand with less than ten percent fines passing the U.S. Standard No. 200 Sieve, unless otherwise approved by the geotechnical engineer. Soils placed adjacent to footings or walls should be carefully compacted with light rubber tired or vibratory plate compactors to avoid damage to the footings or walls. This material should be placed in level lifts not exceeding 8 inches in loose thickness and compacted to a minimum of 95 percent of its modified Proctor

density. Fill placed adjacent to walls should not exceed a density of 98 percent of Proctor density.

3.08 TESTING

A. All soil testing and earthwork monitoring will be done by a testing company in conformance with Paragraph 1.05. The same laboratory employed as part of Section 02222 shall be used for structure backfill density tests. Notify the Testing Lab in time to be on hand to make the tests required by these specifications. Testing Lab will inform the project superintendent his findings and designate areas requiring corrective work.

B. Optimum moisture content of fill material will be by Modified Proctor Method (ASTM D-1557). Conduct field densities to verify compaction in accordance with ASTM D-1556, ASTM D-2927, or ASTM D-2922. Make at least one test per layer for each 1,000 square feet of area of compaction.

C. Retest compaction tests that fail to pass after additional compaction until the specified minimum compaction density is achieved. Two additional tests shall be taken for each failed test. Cost of retest shall be borne by the Contractor.

- END OF SECTION -

SECTION 02276

EROSION AND SEDIMENTATION CONTROL

PART 1 -- GENERAL

1.01 THE REQUIREMENTS

A. The Contractor is responsible for implementing Best Management Practices (BMPs) to prevent and minimize erosion and resultant sedimentation in all cleared and grubbed areas during and after construction. This item covers the work necessary for the installation of structures and measures for the prevention of soil erosion and control of sedimentation. The Contractor shall furnish all material, labor and equipment necessary for the proper installation, maintenance, inspection, monitoring, reporting, and removal (where applicable) of erosion prevention and sediment control measures and, if applicable, to cause compliance with all local permits and the State of Florida Department of Environment and Natural Resources Division of Water Quality General Permit – Discharge Stormwater under the National Pollution Discharge Elimination System for Construction Activities, for any land disturbance or construction activity of one (1) acre or more, under this Section 02276.

B. Any land disturbance as the result of modifications to a site's drainage features or topography requires protection from erosion and sedimentation.

C. All excavations shall be in conformity with the lines, grades, and cross sections shown on the Contract Drawings or established by the Engineer.

D. It is the intent of this Specification that the Contractor conducts the construction activities in such a manner that erosion of disturbed areas and off-site sedimentation be absolutely minimized.

E. All work under this Contract shall be done in conformance with and subject to the limitations of the Florida Rules and Regulations for Erosion and Sedimentation Control as adopted by the Florida Sedimentation Control Commission.

F. The following excerpts from the regulations are particularly important:

1. The angle of graded slopes and fills shall be no greater than the angle that can be retained by vegetative cover or other adequate erosion-control devices or structures.

2. Perimeter dikes, swales, ditches and slopes, disturbed areas within High Quality Water (HWQ) Zones, and slopes steeper than 3H:1V following completion of any phase of grading, shall be planted or otherwise provided with temporary or permanent ground cover, devices, or structures sufficient to restrain erosion **within 7 calendar days**.

3. All other slopes of 3H : 1V or flatter, except those with slopes greater than 50 feet in length or within HWQ Zones, following completion of any phase of grading, shall be planted or otherwise provided with temporary or permanent ground

cover, devices, or structures sufficient to restrain erosion **within 14 calendar days**.

G. Due to the nature of the work required by this Contract, it is anticipated that the location and nature of the erosion and sediment control devices will be adjusted on several occasions to reflect the current phase of construction. The construction schedule adopted by the Contractor will impact the placement and need for specific devices required for the control of erosion. The Contractor shall develop and implement such additional techniques as may be required to minimize erosion and off-site sedimentation. The location and extent of erosion and sedimentation control devices shall be revised at each phase of construction that results in a change in either the quantity or direction of surface runoff from constructed areas. All deviations from the erosion and sedimentation control provisions shown on the Contract Drawings shall have the prior acceptance of the Engineer and shall be completed at no additional cost to the Owner.

H. Erosion and sedimentation controls applicable to this project shall be as shown on the Contract Drawings, as specified herein, as indicated by the Engineer and as detailed in the Florida Erosion and Sediment Control Planning and Design Manual.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 – Submittals

B. Section 02100 – Clearing, Grubbing, and Site Preparation

C. Section 02140 – Dewatering

D. Section 02200 – Earthwork

E. Section 02274 – Geotextiles

F. Section 02500 – Surface Restoration

G. Section 02910 – Final Grading and Landscaping

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. See FDOT EROSION AND SEDIMENT CONTROL DESIGNER AND REVIEWER MANUAL

1.04 REGULATORY COMPLIANCE

A. Land disturbance activities are not authorized to begin until after all required erosion and sediment control permits are obtained from the United States, the State of Florida and local authorities, as necessary. Contractor is the Co-Primary Permittee and Operator under the provisions of the NPDES Permit. As such, the Contractor will be required to sign certain certifications as described in the NPDES Permit. Contractor shall comply with requirements specified in the Contract Documents, on the approved Erosion Control Plan, and by the Engineer. Contractor shall also comply with all other laws, rules, regulations, ordinances and requirements concerning soil erosion and sediment control established in the United States, the State of Florida and local authorities as applicable.

The following documents and the documents referenced therein define the regulatory requirements for this Section 02276.

1. NPDES PERMIT: The Florida Department of Environment and Natural Resources General Permit to Discharge Stormwater under the National Pollution Discharge Elimination System for Construction Activities (NPDES permit) governs land disturbance or construction activities of one (1) acre or more. On applicable sites, Contractor is responsible for complying with terms and conditions of this permit.

2. Manual for Erosion and Sediment Control: Contractor shall follow Practices and Standards of the FDOT Erosion and Sediment Control Designer and Reviewer Manual, latest edition.

B. During the period beginning on the effective date of the permit and lasting until expiration, the Permittee is authorized to discharge stormwater associated with construction activity including clearing, grading and excavation activities resulting in the disturbance of land and related support activities. Such discharges shall be controlled, limited and monitored as specified below.

1. The Contractor, as Co-Primary Permittee and Operator under the provisions of the NPDES Permit, shall submit a plan for compliance with the Owner-provided approved erosion and sedimentation control plan to the Engineer for approval. Plans must include designation of where 7 and 14-day ground stabilization requirements and where basins which comply with surface-withdrawal requirements of the NPDES permit, if applicable, are located. Land disturbing activity shall not commence until the plan is approved by the Engineer. Maintain an up-to-date copy of the approved plan on the site.

2. Implement the approved plan. Deviation from the plan is allowed only to correct emergency situations of sediment discharge offsite or when minor modifications are made to improve performance of the measures and the approval authority has been notified. Note allowed deviations on the plan maintained on the site.

3. Manage onsite activities such that no adverse impacts to water quality occur from site activities or allowed discharges. The following activities, and others on a site-specific basis, require oversight throughout the construction and development process to assure that all water quality standards are protected.

    a. Equipment Operation and Maintenance: Equipment utilized during the construction activity on a site must be operated and maintained in such a manner as to prevent the potential or actual pollution of the surface or ground waters of the State. Fuels, lubricants, coolants, and hydraulic fluids, or any other petroleum products, shall not be discharged onto the ground or into surface waters. Spent fluids shall be disposed of in a manner so as not to enter the waters, surface or ground, of the State and in accordance with applicable state and federal disposal regulations. Any spilled fluids shall be cleaned up to the extent practicable and disposed of in a manner so as not to allow their entry into the waters, surface or ground, of the State.

b. Material Handling: Herbicide, pesticide, and fertilizer usage during the construction activity shall be consistent with the Federal Insecticide, Fungicide, and Rodenticide Act and shall be in accordance with label restrictions.

c. Building Material Waste Handling: All wastes composed of building materials shall be disposed of in accordance with Florida General Statutes, Chapter 130A, Article 9 - Solid Waste Management, and rules governing the disposal of solid waste. In particular, the following guidelines shall be followed:

i. No paint or liquid wastes in streams or storm drains.

ii. Dedicated area for demolition, construction, and other wastes must be located a minimum of 50' from storm drains and streams unless no reasonable alternatives are available.

iii. Earthen-material stockpiles must be located a minimum of 50' from storm drains and streams unless no reasonable alternatives are available.

iv. Concrete materials onsite, including excess concrete, must be controlled to avoid contact with surface waters, wetlands, or buffers. (Note discharges from onsite concrete plants may require coverage under a separate NPDES permit).

d. Litter and Sanitary Waste: The Permittee shall control the management and disposal of litter and sanitary waste from the site.

C. Violations and Fines

1. Contractor shall be responsible for reimbursing the Owner for any fines incurred as a result of violations to the Sedimentation Pollution Control Act, the NPDES General Permit for Stormwater Discharges on Construction Sites, and any applicable delegated local program's sediment control regulations until construction activities are complete and the project is accepted by the Owner.

2. If violations result in the issuance of a Notice of Violation, the Contractor shall comply with the requirements of the Notice within the specified time period for compliance. Failure to comply could result in the assessment of a penalty for each day of the continuing violation, beginning with the date of the violation.

3. Violations may result in civil and/or criminal penalties which include fines and imprisonment.

1.05 SUBMITTALS

A. Prior to the start of the work, the Contractor shall prepare and submit a plan for implementing the temporary and permanent erosion and sedimentation control measures as shown on the Erosion and Sediment Control Plan approved by the

appropriate regulatory authority. Construction work shall not commence until the schedule of work and the methods of operations have been reviewed and approved.

B. The Contractor shall perform inspections of erosion and sedimentation control measures and stormwater discharge outfalls and prepare inspection reports as described in Part 3 of this Section. Copies of the inspection reports shall be submitted to the Engineer on a monthly basis.

C. In accordance with the procedures and requirements set forth in the General Conditions Division 1 and Section 01300 - Submittals, the Contractor shall submit the following:

1. Name and location of all material suppliers.

2. Certificate of compliance with the standards specified above for each source of each material.

3. List of disposal sites for waste and unsuitable materials and evidence of all required permits for use of those sites.

1.06 GUARANTEE

A. All restoration and re-vegetation work shall be subject to the one-year guarantee period of the Contract as specified in the General Conditions.

PART 2 -- MATERIALS

2.01 MATERIALS

A. Materials for use in erosion and sedimentation control devices shall be in accordance with FDOT.

B. All erosion and sediment control bid prices shall include all excavation, grading, maintenance, legal sediment disposal, permits and all other work and appurtenances necessary to design, install and maintain the sediment and erosion control measures as detailed herein and in accordance with FDOT.

2.02 SILT FENCE

A. Silt (or sediment) fence shall be constructed as shown on the Contract Drawings, at other locations indicated by the Engineer, and as specified herein. Silt fences shall be installed below small disturbed areas that are less than ¼ acre disturbed per 100-feet of fence when slopes are less than 2%. Silt fence shall not be installed across streams, ditches, or waterways or other areas of concentrated flows.

B. Silt fence shall be designed, installed and maintained in accordance with Part 3 of this Section. Silt fence shall be a woven geotextile filter fabric made specifically for sediment control. Filter fabric shall not rot when buried and shall resist attack from soil chemicals, alkalines and acids in the pH range from 2 to 13, and shall resist damage due to prolonged ultraviolet exposure. Filter fabric shall be C-50NW as manufactured by Contech Earth Stabilization Solutions, GT 142 as manufactured by SKAPS Industries,

Soiltex ST 120N as manufactured by Geo-Synthetics, Inc., or approved equal. The cost of silt fence shall include the materials, excavation, backfill, aggregate, etc. and all maintenance and restoration activities required.

C. Silt fence shall be stable for the 10-year peak storm runoff. Fabric shall meet the following specifications:

Temporary Silt Fence Material Property Requirements					
	Test Material	**Units**	**Supported[1] Silt Fence**	**Un-Supported[1] Silt Fence**	**Type of Value**
Grab Strength	ASTM D 4632	N (lbs)			
Machine Direction			400	550	MARV
			(90)	(90)	
x-Machine Direction			400	450	MARV
			(90)	(90)	
Permittivity[2]	ASTM D 4491	sec-1	0.05	0.05	MARV
Apparent Opening Size[2]	ASTM D 4751	mm	0.60	0.60	Max. ARV[3]
		(US Sieve #)	(30)	(30)	
Ultraviolet Stability	ASTM D 4355	% Retained Strength	70% after 500 hours exposure	70% after 500 hours exposure	Typical

[1] Silt Fence support shall consist of 14 gage steel wire with a mesh spacing of 150 mm (6 inches), or prefabricated polymer mesh of equivalent strength.

[2] These default values are based on empirical evidence with a variety of sediment. For environmentally sensitive areas, a review of previous experience and/or site or regionally specific geotextile tests in accordance with Test Method D 5141 should be performed by the agency to confirm suitability of these requirements.

[3] As measured in accordance with Test Method D 4632.

D. The synthetic filter fabric shall consist of at least 95% by weight of polyolefins or polyester, certified by the manufacturer.

E. The posts for silt fences shall be 1.33 lb/linear feet steel with a minimum length of 5 feet; posts shall have projections to facilitate fastening of the fabric.

F. For reinforcement of standard strength filter fabric use wire fence with a minimum 14 gauge and a maximum mesh spacing of 6 inches.

2.03 STONE FOR EROSION CONTROL

A. The Contractor shall place stone for erosion control as shown on the Contract Drawings, as specified herein, as specified in the FDOT Standard Specifications. The stone for erosion control shall consist of field stone or rough un-hewn quarry stone. The stone shall be sound, tough, dense, and resistant to the action of air and water. The stone for erosion control shall be Class (A) or Class (B) as specified in the FDOT Standard Specifications, unless otherwise shown on the Contract Drawings.

B. Stone for erosion control shall be designed, installed and maintained in accordance with the FDOT Standard Specifications. The cost for stone for erosion control shall include furnishing, weighing, stockpiling, re-handling, placing and maintaining stone; disposal of any stone not incorporated into the project if directed by the Engineer; and any other incidentals necessary to complete the work.

2.04 RIP RAP

A. The Contractor shall place rip rap as shown on the Contract Drawings, as specified in the FDOT Standard specifications for plain rip rap. The stone for rip rap shall consist of field stone or rough un-hewn quarry stone. The rip rap shall be sound, tough, dense, and resistant to the action of air and water. Neither the width nor thickness of individual stones shall be less than one third their length. The rip rap shall be Class 1 or Class 2 as specified in the FDOT Standard Specifications, unless otherwise shown on the Contract Drawings.

B. Rip rap shall be designed, installed and maintained in accordance with Part 3 of this Section, and FDOT Standard Specifications. The cost for rip rap shall include furnishing, weighing, stockpiling, rehandling, placing and maintaining rip rap; disposal of any rip rap not incorporated into the project if directed by the Engineer; and any other incidentals necessary to complete the work.

2.06 TEMPORARY AND PERMANENT DIVERSIONS

A. Temporary diversions shall be constructed as shown on the Contract Drawings, at other locations indicated by the Engineer, as specified herein, and in the FDOT Standard Specifications. Permanent diversions shall be constructed as shown on the Contract Drawings, and at other locations indicated by the Engineer. Temporary diversions shall be constructed adjacent to disturbed areas to collect surface runoff from disturbed areas and direct the runoff to sediment basins or to divert non-sediment laden runoff away from undisturbed areas and/or sediment basins. All temporary diversions transporting sediment-laden runoff shall terminate in a sediment trapping device. Permanent diversions should be planned as a part of initial site development and should be coordinated with temporary diversions. All temporary and permanent diversions shall be stabilized with vegetation or other means within 7 days of installation. Permanent diversions shall be used to divert water to locations where it can be used or released without erosion or flood damage. Dimensions shall be as shown on the Contract Drawings.

B. Temporary diversions shall be designed, installed and maintained in accordance with Part 3 of this Section, and to the satisfaction of the Engineer, until the site has been stabilized. Permanent diversions shall be designed, installed and maintained in accordance with Part 3 of this Section. The cost of temporary and permanent diversions shall include the excavation, grading, materials, etc. and all maintenance and restoration activities required.

2.08 TEMPORARY GRAVEL CONSTRUCTION ENTRANCES/EXITS

A. Temporary gravel construction entrances/exits shall be located at points where vehicles enter and leave a construction site, at other locations indicated by the Engineer, as

specified herein, and as detailed in FDOT Erosion and Sediment Control Designer and Reviewer Manual.

B. Temporary gravel construction entrances/exits shall be constructed with a minimum 6 inch layer of 2 – 3 inch washed stone placed over a stable foundation and shall be a minimum of 100 feet in length and 25 feet in width. Geotextile fabric shall be used under stone as shown on the Contract Drawings.

C. Temporary gravel construction entrances/exits shall be designed, installed and maintained in accordance with Part 3 of this Section and FDOT Erosion and Sediment Control Designer and Reviewer Manual, to the satisfaction of the Engineer, until the site has been stabilized. The cost of temporary gravel construction entrances/exits shall include the materials and all maintenance activities required, including additional tire washing as may be necessary.

2.09 TEMPORARY AND PERMANENT STABILIZATION OF DISTURBED AREAS

A. Temporary and permanent stabilization of disturbed areas will be provided at the locations shown on the Contract Drawings, at other locations indicated by the Engineer, and as specified herein. The Contractor shall provide ground cover adequate to restrain erosion on disturbed areas that will be left un-worked for periods exceeding 7 to 14 days, as noted in Section 1.01. F. of this specification.

B. Seed mixtures shall be selected based on site location and seasonal recommendations. Sod shall be selected based on site location and intended use.

C. Mulch shall be as detailed in contract drawings and documents

D. Temporary soil stabilizer shall consist of an especially prepared highly concentrated powder which, when mixed with water, forms a thick liquid such as "Enviroseal 2001" by Enviroseal Corporation, "Terra Control" by Quattro Environmental, Inc., or "CHEM-CRETE ECO-110" by International CHEM-CRETE Corporation, and having no growth or germination inhibiting factors. The agent shall be used for hydroseeding grass seed in combination with other approved amendments resulting in a highly viscous slurry which, when sprayed directly on the soil, forms a gelatinous crust.

E. Temporary and permanent stabilization of disturbed areas shall be achieved in accordance with Part 3 of this Section. The cost of temporary and permanent stabilization of disturbed areas shall include all grading, excavation and materials as well as all reseeding and other maintenance activities required until stabilization is achieved.

2.11 INLET EROSION CONTROL MEASURES

A. Yard, Curb and other Inlet Erosion Control Measures shall be constructed at the locations shown on the Contract Drawings, at other locations indicated by the Engineer, and as specified herein. Inlet erosion control measures shall be used to prevent or limit the introduction of sediment to storm drain systems and allow early use of the of the storm drainage system. Maximum drainage areas for inlet erosion control measures vary from 1 acre for excavated drop inlet protection, hardware & cloth gravel inlet protection, and block and gravel inlet protection to more than 5 acres for rock pipe inlet protection. In addition to the inlet protection measures described in the FDOT Standard

Specifications, other measures may be specified by the Engineer. For measures not detailed in the FDOT Standard Specifications, the materials will be as specified by the Engineer's and Manufacturer's instructions, with more stringent specifications superseding.

B. Materials for Inlet Erosion Control Measures consist of silt fence, riprap, stone (gravel), hardware wire, sod, concrete blocks, and sediment logs. Riprap and stone for erosion control shall be as specified herein. Hardware wire shall be as specified in FDOT Erosion and Sediment Control Designer and Reviewer Manual. Sod shall conform to the specifications set forth in FDOT Erosion and Sediment Control Designer and Reviewer Manual. Concrete blocks shall be as specified in FDOT Erosion and Sediment Control Designer and Reviewer Manual. Material specifications for sediment logs appear within. If Manufacturer's recommendations are more stringent, they shall supersede.

C. Inlet Erosion Control Measures shall be designed, installed and maintained in accordance with Part 3 of this Section and FDOT Erosion and Sediment Control Designer and Reviewer Manual. Measures not described in the FDOT Erosion and Sediment Control Designer and Reviewer Manual shall be designed, installed, and maintained in accordance with the Engineer's and Manufacturer's instructions, with more stringent instructions superseding. The cost of inlet erosion control measures shall include all excavation, grading and materials as well as all maintenance activities required.

2.14 TEMPORARY SEDIMENT TRAPS, SEDIMENT BASINS, AND SKIMMER SEDIMENT BASINS

A. Temporary sediment traps shall be constructed as shown on the Contract Drawings, at the termination of all temporary diversions diverting sediment laden runoff, at other locations indicated by the Engineer, as specified herein, and as detailed in FDOT Erosion and Sediment Control Designer and Reviewer Manual. These temporary measures shall not be constructed within an intermittent or perennial stream and shall be installed prior to any land disturbance activities within the drainage area. Temporary sediment traps shall be constructed by excavating the appropriate size rectangular basin and constructing a rock-fill dam on the discharge end. Where specific elevations are not indicated on the Contract Drawings, Contractor shall maintain basins at the depths shown below working grades.

B. Sediment basins shall be installed at the locations shown on the Contract Drawings, at other locations indicated by the Engineer, as specified herein, and as detailed in FDOT Erosion and Sediment Control Designer and Reviewer Manual. Skimmer sediment basins shall be installed at the locations shown on the Contract Drawings, at other locations indicated by the Engineer, as specified herein, and as detailed in FDOT Erosion and Sediment Control Designer and Reviewer Manual. Sediment basins and skimmer sediment basins shall be used where drainage areas are too large for temporary sediment traps. **Outlet structures must withdraw from basin surface unless drainage area is less than 1 acre.** They shall retain sediment on the site and prevent off site sediment in waterways, and they shall not be located in intermittent or perennial streams. Sediment basins and skimmer sediment basins shall be installed prior to any land disturbance activities within the drainage area.

C. Porous baffles shall be installed in temporary sediment traps, sediment basins, and skimmer sediment basins as shown on the Contract Drawings, at other locations indicated by the Engineer, as specified herein, and as detailed in FDOT Erosion and Sediment Control Designer and Reviewer Manual. Porous baffles are used to reduce the velocity and turbulence of the water flowing through the structure and to facilitate the settling of sediment in the water before discharge. They effectively spread the flow across the entire width of a structure.

D. Material used for porous baffles shall be as indicated on the Contract Drawings. Typical materials include silt fence, coir erosion blanket, coir mesh, and tree protection fence. Other materials may be used as noted on the Contract Drawings and indicated by the Engineer.

E. The structure life for temporary sediment traps shall be limited to 2 years. Temporary sediment traps shall be spaced to limit the maximum tributary drainage area to 5 acres. The basin life of sediment basins and skimmer sediment basins shall be limited to 3 years unless they are designed as permanent structures. The drainage area for sediment basins and skimmer sediment basins shall be limited to 100 acres.

F. The principal spillway for sediment basins shall consist of a riser and barrel. Ensure that the pipe is capable of withstanding the maximum expected load without yielding, buckling, or cracking. The basin should be provided with a skimmer or flashboard riser to dewater the basin from the water surface. The emergency spillway shall be constructed in undisturbed soil. The principal spillway outlet and emergency spillway shall be stabilized as shown on the Contract Drawings. Materials shall be as noted on the Contract Drawings.

F. The principal spillway for skimmer sediment basins shall consist of a skimmer which dewaters the basin from the top of the water surface at a controlled rate. A dewatering rate of 24 to 72 hours is required. The skimmer outlet pipe shall be capable of withstanding the maximum expected load without yielding, buckling, or cracking. The emergency spillway shall be constructed in undisturbed soil whenever possible and shall be lined with impermeable geotextile fabric in accordance with Section 02274 – Geotextiles. The principal spillway outlet and emergency spillway shall be stabilized as shown on the Contract Drawings.

G. Temporary sediment traps shall be designed, constructed and maintained in accordance with Part 3 of this Section and the FDOT Erosion and Sediment Control Designer and Reviewer Manual, to the satisfaction of the Engineer, until the sediment producing areas have been permanently stabilized. The cost of the temporary sediment traps shall include the excavation, grading, fill, baffles, stone for erosion control, washed stone, geotextile, etc. and all maintenance activities required.

H. Sediment basins shall be designed, installed and maintained in accordance with Part 3 of this Section and FDOT Erosion and Sediment Control Designer and Reviewer Manual. Skimmer sediment basins shall be designed, installed and maintained in accordance with Part 3 of this Section and FDOT Erosion and Sediment Control Designer and Reviewer Manual. The cost of sediment basins and skimmer sediment basins shall include all excavation, grading and materials as well as all maintenance activities required.

I. Porous baffles shall be designed, installed and maintained in accordance with Part 3 of this Section and the FDOT Erosion and Sediment Control Designer and Reviewer Manual. The cost of porous baffles shall include all excavation, grading and materials as well as all maintenance activities required.

2.15 OUTLET STABILIZATION STRUCTURE

A. Outlet stabilization structures shall be constructed at the locations shown on the Contract Drawings, at other locations indicated by the Engineer, as specified herein, and as detailed in FDOT Erosion and Sediment Control Designer and Reviewer Manual. These structures shall be used where the discharge velocity of the upstream water conveyance structure exceeds the permissible velocity of the receiving channel or disposal area.

B. Structures shall be sized for a capacity equivalent to a 10-year, peak runoff or design discharge of the water conveyance structure, whichever is greater. Riprap materials shall be as specified on the Contract Drawings. Filter fabric shall be Type II Separator Geotextile, as specified in Section 02274 – Geotextiles.

C. Outlet stabilization structures shall be designed, installed and maintained in accordance with Part 3 of this Section and the FDOT Erosion and Sediment Control Designer and Reviewer Manual. The cost of outlet stabilization structures shall include all excavation, grading and materials as well as all maintenance activities required.

PART 3 -- EXECUTION

3.01 INSTALLATION AND MAINTENANCE

A. All installation and maintenance shall be conducted in accordance with this specification and the FDOT Erosion and Sediment Control Designer and Reviewer Manual. In the event of a discrepancy between this specification, Manufacturer's recommendations and the FDOT Erosion and Sediment Control Designer and Reviewer Manual, the more stringent requirements shall take precedence.

B. If applicable, all requirements of the NPDES Permit shall be followed. In the event of a discrepancy between this specification and the NPDES Permit requirements, the more stringent requirements shall take precedence.

C. If possible, erosion and sedimentation control devices shall be established prior to clearing operations in a given area. Where such practice is not feasible, the erosion and sedimentation control device(s) shall be established concurrent with the clearing operations or immediately following completion of the clearing operations.

D. The Contractor shall furnish the labor, materials and equipment required for routine maintenance of all erosion and sedimentation control devices. At a minimum, maintenance shall be scheduled as required for a particular device to maintain the removal efficiency and intent of the device. Note that specific maintenance intervals for various measures and practices are specified within the FDOT Erosion and Sediment Control Designer and Reviewer Manual. Of the maintenance requirements specified herein and in the FDOT Erosion and Sediment Control Designer and Reviewer Manual,

the more stringent shall take precedence for each and every sediment and erosion control measure utilized on the site. Maintenance shall include but not be limited to 1) the removal and satisfactory, legal disposal of accumulated sediment from traps or silt barriers and 2) replacement of filter fabrics used for silt fences and stone impaired by sediment in stone filters, gravel construction entrances, etc. Maintenance as noted in items 1) and 2) above shall be performed as required, and at least once every 3 months for the duration of construction activities. Sediment removed from erosion and sedimentation control devices shall be disposed of in locations that will not result in off-site sedimentation as acceptable to the Engineer, at no additional cost to the Owner. If no suitable on site locations are available, all such sediment will be legally disposed of off site, at no additional cost to the Owner.

3.02 SILT FENCE

A. Silt Fence shall be designed, installed and maintained in accordance with the requirements of FDOT Erosion and Sediment Control Designer and Reviewer Manual. Silt fence shall be erected at the locations shown on the Contract Drawings and at all other locations as may be directed by the Engineer. Silt fence shall be erected and maintained to the satisfaction of the Engineer until a vegetative ground cover has been established. Replacement of the filter fabric and its associated appurtenances, if required by the Engineer, will be at the Contractor's expense.

B. Silt fence shall not be installed across streams, ditches, waterways or other areas of concentrated flow.

C. Dig a trench approximately 8 inches deep and 4 inches wide and place the fabric in the bottom of the excavated ditch or use the slicing method to insert the fabric into a cut sliced in the ground with a disc. Ensure that the height of the sediment fence does not exceed 24 inches above the ground surface.

D. Install posts 4 feet apart in critical areas and 6 feet apart on standard applications when extra strength filter fabric is used. When wire mesh support is used, posts shall be installed a maximum of 8 feet apart. Install posts 2 feet deep on the downstream side of the silt fence, as close as possible to the fabric.

E. Joints should be avoided along the fencing. When joints are necessary, securely fasten the filter cloth only at a support post with 4 feet minimum overlap to the next post.

F. Compaction is vitally important for effective results. Compact the soil immediately next to the silt fence fabric with the front wheel of the tractor, skid steer or roller exerting at least 60 pounds per square inch. Compact the upstream side first and then each side twice for a total of 4 trips.

G. Stabilized outlets for silt fence shall be provided at locations shown on the Contract Drawings. The outlet section shall have a maximum width of 4 feet. The height of silt fence at the outlet shall be a maximum of 1 foot. A 5 foot x 5 foot (minimum) apron of #57 washed stone shall be provided on the downstream side of the silt fence outlet.

H. Silt fence shall be erected around all catch basins which are located downstream from any construction work unless other inlet protection is specified. Should any catch basins be indicated to be relocated or modified, silt fence shall be utilized until work is

completed on the catch basins. Upon completion of the modification, the area shall be rough graded, as shown on the Contract Drawings, until the end of the project, at which time final grading shall occur.

I. Inspect silt fence at least once a week and after each rainfall event. Make any required repairs immediately.

J. Should the fabric of any silt fence collapse, tear, decompose or become ineffective, replace it promptly. All fabric shall be replaced after the first 3 months of construction activity and every 3 months thereafter until construction activities are complete.

K. Remove sediment deposits as necessary to provide adequate storage volume for the next rain and to reduce pressure on the fence. Take care to avoid undermining the fence during cleanout.

L. Remove all fencing materials and unstable sediment deposits and bring the area to grade and stabilize it after the contributing drainage area has been properly stabilized. Removal of any silt fence shall be permitted only with the prior approval of the Engineer or the local governing agency.

3.03 STONE FOR EROSION CONTROL

A. Stone for erosion control shall be designed, installed, and maintained in accordance with the requirements of FDOT Erosion and Sediment Control Designer and Reviewer Manual. Stone for erosion control shall be dumped and placed in such manner that the larger rock fragments are uniformly distributed throughout the rock mass and the smaller fragments fill the voids between the larger fragments. Rearranging of individual stones by equipment or by hand shall only be required to the extent necessary to secure the results specified above, to protect structures from damage when rock material is placed against the structures, or to protect the underlying Separator Geotextile from damage during installation.

B. Inspect at least weekly and within 24 hours after any storm event of greater than ½ inch of rain per 24-hour period. Remove accumulated sediment and replace stone impaired by sediment as necessary.

3.04 RIPRAP

A. Riprap shall be designed, installed and maintained in accordance with the requirements of FDOT Erosion and Sediment Control Designer and Reviewer Manual. Riprap shall be graded so that the smaller stones are uniformly distributed through the mass. The Contractor may place the stone by mechanical methods, augmented by hand placing where necessary or ordered by the Engineer. The placed riprap shall form a properly graded, dense, neat layer of stone. The placed riprap shall have a minimum depth of 24 inches unless otherwise specified by the Engineer. Type II Separator Geotextile, as specified in Section 02274 – Geotextiles, shall be used under all riprap unless otherwise noted.

B. Inspect periodically for scour or dislodged stones. Control of weed and brush growth may be needed.

3.06 TEMPORARY AND PERMANENT DIVERSIONS

A. Temporary diversions shall be designed, installed and maintained in accordance with the requirements of FDOT Erosion and Sediment Control Designer and Reviewer Manual. Permanent diversions shall be designed, installed, and maintained in accordance with the requirements of the FDOT Erosion and Sediment Control Designer and Reviewer Manual. The Contractor shall provide temporary and permanent diversions at all locations noted on the Contract Drawings and at all other locations as may be directed by the Engineer.

B. Remove and properly dispose of all trees, debris, etc. Fill and compact all ditches, swales, etc. that will be crossed to natural ground level or above.

B. Excavate, shape and stabilize diversions as shown on the Contract Drawings and described herein. Unless otherwise noted, provide vegetative stabilization immediately after installation of permanent diversions. Temporary diversions that are to serve longer than 7 working days shall be seeded and mulched as soon as they are constructed to preserve dike height and reduce maintenance. Seed and mulch disturbed areas draining into the diversions within 14 calendar days of completing any phase of grading.

C. For temporary diversions, ensure that the top of the dike is not lower at any point than the design elevation plus the specified settlement. Provide sufficient room around temporary diversions to permit machine re-grading and cleanout. Vegetate the ridge of temporary diversions immediately after construction unless they will remain in place less than 7 working days.

B. Provide outlet protection adequate to accept flow from diversion plus any other contributing runoff. Sediment-laden runoff shall be routed through a sediment-trapping device.

C. Inspect temporary diversions once a week and after every rainfall event. Immediately remove sediment from the flow area and repair the diversion ridge. Carefully check outlets and make timely repairs as needed. When the area protected is permanently stabilized, remove the ridge and the channel to blend with the natural ground level and appropriately stabilize it. Inspect permanent diversions weekly and after every rainfall event during construction operations until permanent vegetation is established. After vegetation is established, inspect after major storms. Immediately remove any debris and make repairs as needed in a timely manner. Maintain healthy vegetation at all times.

3.08 TEMPORARY GRAVEL CONSTRUCTION ENTRANCES/EXITS

A. Temporary gravel construction entrances/exits shall be designed, installed and maintained in accordance with the requirements of FDOT Erosion and Sediment Control Designer and Reviewer Manual. The Contractor shall provide temporary gravel construction entrances/exits at all locations noted on the Contract Drawings and at all other locations as may be directed by the Engineer.

A. Maintain the gravel pad as specified in the FDOT Erosion and Sediment Control Designer and Reviewer Manual and in a condition to prevent mud or sediment from leaving the construction site. This may require periodic topdressing with 2 – 3 inch

stone. Inspect each construction entrance at least weekly and after each rainfall event and replace stone impaired by sediment as necessary. Immediately remove all objectionable materials spilled, washed, or tracked onto public roadways.

B. If, despite the use of a gravel construction entrance/exit, most of the mud and sediment are not removed from vehicle tires, tire washing may be necessary as detailed in FDOT Erosion and Sediment Control Designer and Reviewer Manual. If necessary this shall be done at no additional cost to the Owner.

3.09 TEMPORARY AND PERMANENT STABILIZATION OF DISTURBED AREAS

A. The Contractor shall temporarily stabilize disturbed areas that will not be brought to final grade within 14 calendar days unless as noted in 1.01 F. of this Section. Temporary seeding shall be applied on areas that include diversions, dams, temporary sediment basins, temporary road banks and topsoil stockpiles. Areas to be stabilized with permanent vegetation must be seeded or planted within 14 working days after final grade is reached, unless temporary stabilization is applied. Temporary seeding provides protection for no more than 1 year, after which permanent stabilization should be initiated.

B. Complete grading before preparing seedbeds, and install all necessary erosion control measures. Minimize steep slopes. If soils become compacted during grading, loosen to a depth of 6-8 inches.

C. Reseed and mulch temporary seeding areas where seedling emergence is poor, or where erosion occurs, as soon as possible. Do not mow. Protect from traffic as much as possible.

D. Refer to FDOT Erosion and Sediment Control Designer and Reviewer Manual for additional information and specifications regarding seedbed requirements, plant selection, seeding and mulching for temporary seeding applications.

E. The operation of equipment is restricted on slopes steeper than 3:1. Provisions for vegetation establishment can be made during final grading. Vegetation chosen for these sites must not require mowing or other intensive maintenance. Good mulching practices are critical for protecting against erosion on steep slopes.

F. Generally, a stand of vegetation cannot be determined to be fully established until soil cover has been maintained for one full year from planting. Inspect seeded areas for failure and make necessary repairs and reseedings within the same season, if possible.

G. Reseeding – If a stand has inadequate cover, re-evaluate choice of plant materials and quantities of lime and fertilizer. Re-establish the stand after seedbed preparation or over-seed the stand. Consider seeding temporary, annual species if the time of year is not appropriate for permanent seeding.

C. If vegetation fails to grow, soil must be tested to determine if acidity or nutrient imbalance is responsible.

D. Fertilization - On the typical disturbed site, full establishment usually requires re-fertilization in the second growing season. Fine turf requires annual maintenance

fertilization. Use soil tests if possible or follow the guidelines given for the specific seeding mixture.

E. Refer to FDOT Erosion and Sediment Control Designer and Reviewer Manual for additional information and specifications regarding seedbed requirements, plant selection, seeding and mulching for permanent seeding applications.

F. Refer to FDOT Erosion and Sediment Control Designer and Reviewer Manual for additional information and specifications regarding soil preparation, sod selection, installation, and maintenance for sodding.

G. Inspect all seeded areas weekly and after heavy rains until permanent cover is established. Inspect within 6 weeks of planting to see if stands are adequate. Fertilize, reseed and mulch damaged and sparse areas immediately.

3.11 INLET EROSION CONTROL MEASURES

A. Inlet erosion control measures shall be designed, installed and maintained in accordance with the applicable requirements of FDOT Erosion and Sediment Control Designer and Reviewer Manual. If inlet erosion control measures shown on the Contract Drawings are not included in the FDOT Erosion and Sediment Control Designer and Reviewer Manual, Engineer's and Manufacturer's instructions for design, installation, and maintenance shall be followed, with more stringent instructions superseding. The Contractor shall provide inlet erosion control measures at all locations noted on the Contract Drawings, and at all other locations as may be directed by the Engineer.

B. Excavated drop inlet protection shall be installed and maintained in accordance with FDOT Erosion and Sediment Control Designer and Reviewer Manual. Drainage area is limited to 1 acre. The minimum volume of excavated area around the drop inlet is 1800 ft^3/acre disturbed. Minimum depth of the excavated area shall be 1 foot and maximum depth shall be 2 feet as measured from the crest of the inlet structure. Weep holes shall be protected by gravel. Inspect the excavated basin at least weekly and after every storm event until the contributing drainage area has been permanently stabilized. Remove sediment when the storage volume has been reduced by one-half.

C. Block and gravel inlet protection shall be installed and maintained in accordance with FDOT Erosion and Sediment Control Designer and Reviewer Manual. Drainage area shall be limited to 1 acre unless site conditions allow for frequent removal of accumulated sediment. The height of the block barrier shall be no more than 12 inches and no less than 24 inches. On the bottom row, place some of the blocks on their side to allow for dewatering. Place wire mesh over all block openings to hold gravel in place. Lateral support may be provided by placement of 2 x 4 wood studs through block openings. Place gravel 2 inches below the top of the block barrier. The top elevation of the structure must be at least 6 inches below the ground elevation downslope from the inlet to ensure that all stormwater flows over the structure and enters the storm drain instead of bypassing the structure. Block and gravel inlet protection shall not be used near the edge of fill material and shall not divert water away from the storm drain. Inspect at least weekly and after every storm event until the contributing drainage area has been permanently stabilized. Remove sediment as necessary to provide adequate storage volume for subsequent rains. Replace stone as needed.

D. Rock pipe inlet protection shall be installed and maintained in accordance with FDOT Erosion and Sediment Control Designer and Reviewer Manual. Rock pipe inlet protection may be used at pipes with a maximum diameter of 36 inches. It shall not be installed in intermittent or perennial streams. The minimum crest width of the riprap berm shall be 3 feet, with a minimum bottom width of 11 feet and minimum height of 2 feet. The top of the riprap shall be 1 foot lower than the shoulder of the embankment or diversions. The outside face of the riprap should be covered with a 12-inch thick layer of #5 or #57 washed stone. The sediment storage area should be excavated upstream of the rock pipe inlet protection, with a minimum depth of 18 inches below grade. The rock pipe inlet protection shall be inspected at least weekly and after any storm event of greater than ½ inch of rain per 24-hour period. Repairs shall be made immediately. Remove sediment when the volume of the sediment storage area has been decreased by one-half and replace the contaminated part of the gravel facing.

3.14 TEMPORARY SEDIMENT TRAPS, SEDIMENT BASINS, AND SKIMMER SEDIMENT BASINS

A. Temporary sediment traps shall be designed, installed and maintained in accordance with the requirements of FDOT Erosion and Sediment Control Designer and Reviewer Manual. Sediment basins shall be designed, installed and maintained in accordance with the requirements of the FDOT Erosion and Sediment Control Designer and Reviewer Manual. Skimmer sediment basins shall be designed, installed and maintained in accordance with the requirements of FDOT Erosion and Sediment Control Designer and Reviewer Manual. The Contractor shall provide these structures at all locations shown on the Contract Drawings and at all other locations as may be directed by the Engineer.

B. Care shall be taken to ensure that proper site preparation operations are conducted prior to trap or basin construction. Clear, grub and strip embankment location.

C. A cut-off trench shall be excavated along the center line of the earth fill embankment for sediment basins and skimmer sediment basins. Keep the trench dry during backfilling and compaction operations.

D. Fill material shall be free of roots, woody vegetation, rocks, and other objectionable materials. Fill shall be placed in 6 to 8 inch layers and compacted. Construct the embankment to an elevation 10 percent (minimum of 6 inches) higher than the design height to allow for settling.

E. Inlets to the sediment traps and basins shall be constructed so as to prevent erosion. Use diversions to divert sediment-laden water to the upper end of the basin.

F. Shape the sediment trap or basin to the specified dimensions.

G. Following construction of the embankment, clear the sediment trap or basin area below the crest elevation of the spillway to facilitate sediment cleanout. Provide access for cleanout of accumulated sediment.

H. Spillway/outlet configuration shall be constructed as specified below.

I. Temporary sediment trap

1. Construct riprap outlet in embankment. Use filter fabric or a keyway cutoff trench between the riprap and the soil to protect it from piping. The outlet weir must be level and constructed to grade to assure design capacity**.** Ensure that the stone spillway outlet extends downstream past the toe of the embankment until the outlet velocity is acceptable for the receiving stream.

2. Provide emergency bypass in natural, stable areas, located so that flow will not damage the embankment.

J. Sediment basin

1. Securely attach the riser to the barrel or barrel stub to make a watertight structural connection. Secure all barrel connections with approved watertight assemblies. Install anti-seep collar(s) as noted on the Contract Drawings. Ensure that the pipe stays in firm contact with its foundation when compacting fill around the pipe. Do not use pervious material as backfill around the pipe. Anchor the riser to prevent floatation. Install trash guard to prevent the riser and barrel from becoming clogged.

2. Install basin dewatering mechanism as noted on the Contract Drawings.

3. Install outlet protection as specified at principal spillway outlet. Install the emergency spillway in undisturbed soil and provide stabilization as specified.

K. Skimmer sediment basin

1. Excavate a shallow pit under the skimmer or provide a low support of stone or timber under the skimmer to prevent the skimming device from settling into the mud.

2. Place the barrel on a firm, smooth foundation of impervious soil. Do not use pervious material to backfill around the pipe. Ensure that the barrel stays in firm contact with its foundation when compacting fill around the pipe.

3. Assemble the skimmer following the Manufacturer’s instructions, or as designed.

4. Lay the assembled skimmer on the bottom of the basin with the flexible joint at the inlet of the barrel pipe. Attach the flexible joint to the barrel pipe and position the skimmer over the excavated pit or support. Attach a rope to the skimmer and anchor it to the side of the basin so that the skimmer may be pulled to the side for maintenance.

5. Install the spillway in undisturbed soil to the greatest extent possible and line with laminated plastic or impermeable geotextile fabric. Anchor the edges of the fabric in a trench with staples or pins. Install outlet protection as specified at the principal spillway outlet.

L. Install porous baffles in temporary sediment traps, sediment basins, and skimmer sediment basins as shown on the Contract Drawings and as specified herein. Porous baffles shall be designed, installed and maintained in accordance with the requirements

of FDOT Erosion and Sediment Control Designer and Reviewer Manual. The Contractor shall provide porous baffles at all locations noted on the Contract Drawings, and at all other locations as may be directed by the Engineer.

1. Care shall be taken when installing porous baffles so they perform as designed. Baffle material shall be secured at the bottom and sides of sediment trap or basin. Fabric shall not be spliced but a continuous piece shall be used across the trap or basin.

2. Install at least three rows of baffles between the inlet and outlet discharge point. Sediment traps and basins less than 20 feet in length may use 2 baffles.

3. Posts or saw horses shall be installed across the width of the sediment trap or basin unless an alternate baffle configuration is shown on the Contract Drawings. Steel posts shall be driven to a depth of 24 inches, spaced a maximum of 4 feet apart. Baffle weirs shall be installed at locations and according to details on the Contract Drawings. Except in locations of baffle weirs, the top of the fabric shall be 6 inches higher than the invert of the spillway and 2 inches lower than the top of the berms.

M. Sediment traps and basins shall be constructed so that the area disturbed and resulting erosion is minimized. The emergency spillway, embankment, and all other disturbed areas above the crest of the principal spillway are to be stabilized immediately after construction.

N. Sediment traps and basins may attract children and should be considered dangerous. Steep side slopes should be avoided and fences with warning signs may be necessary if trespassing is likely.

O. Inspect temporary sediment traps, sediment basins, and skimmer sediment basins once a week and within 24 hours after any storm event of greater than ½ inch of rain per 24-hour period. Repairs shall be made immediately.

1. Sediment, limbs and other debris shall be cleared and the trap or basin shall be restored to its original dimensions when it accumulates to one-half the design depth or more frequently as directed by the Engineer. Sediment material removed from traps and basins shall be disposed of by the Contractor in locations that will not result in off-site sedimentation as acceptable to the Engineer, at no additional cost to the Owner. If no suitable on site locations are available, all such sediment will be legally disposed of off site, at no additional cost to the Owner.

2. The embankment, spillways and outlet shall be checked for erosion damage and the embankment shall be checked for piping and settlement. Immediately fill any settlement of the embankment to slightly above design grade. Any riprap displaced from the spillway must be replaced immediately. Replace contaminated gravel facing of riprap outlets as necessary. Inspect vegetation. Reseed and re-mulch as necessary.

3. Baffles, fabric and skimmer shall be inspected for damage. Repairs shall be made immediately. Re-anchor baffles if water is flowing under or around them.

4. Debris shall be removed from the skimmer to prevent clogging. Special precautions shall be taken in winter to prevent the skimmer from plugging with ice.

3.15 OUTLET STABILIZATION STRUCTURE

A. Outlet stabilization structures shall be designed, installed and maintained in accordance with the requirements of FDOT Erosion and Sediment Control Designer and Reviewer Manual.

B. The Contractor shall ensure the subgrade, riprap and gravel filter conforms to the grading limits shown on the plans.

C. Riprap shall be installed in accordance with the specifications contained herein, with filter fabric placed under the riprap.

D. The apron shall be constructed on zero grade with no overfill. Ensure the apron is properly aligned with the receiving stream.

E. All disturbed areas shall be stabilized with vegetation immediately after construction.

F. Outlet stabilization structures shall be inspected at least weekly and within 24 hours after any storm event of greater than ½ inch of rain per 24-hour period to see if any erosion around or below the riprap has taken place or if stones have been dislodged. Repairs shall be made immediately.

3.18 ADDITIONAL REQUIREMENTS

A. All storm sewer piping shall be blocked at the end of every working day until the inlet is constructed above grade.

B. All streets around the construction area shall be scraped as necessary to prevent accumulation of dirt and debris.

C. The Contractor shall provide adequate means to prevent any sediment from entering any storm drains, curb inlets (curb inlet filter box), ditches, streams, or bodies of water downstream of any area disturbed by construction. Excavation materials shall be placed upstream of any trench or other excavation to prevent sedimentation of offsite areas. Silt fence will be provided, at no additional cost to the Owner, around excavation materials if deemed necessary by the Engineer. In areas where a natural buffer area exists between the work area and the closest stream or water course, this area shall not be disturbed.

D. The Engineer may direct the Contractor to place any additional sediment and erosion control devices at other locations not shown on the Drawings.

3.19 INSPECTIONS AND MAINTENANCE

A. The Contractor shall designate an Authorized Representative to perform inspections and maintenance as described herein. Contractor shall perform regular inspections and maintain records as follows:

1. Inspections shall be performed, at a minimum, once every seven calendar days and within 24 hours after any storm event of greater than ½ inch of rain per 24 hour period.

2. A rain gauge shall be maintained in good working order on the site and all rainfall amounts recorded throughout the duration of construction activities.

3. Inspection reports must be available on-site during business hours unless a site-specific exemption is approved.

4. Inspection records must be kept for 3 years following completion of construction and be available upon request.

5. Electronically-available records may be substituted under certain conditions as approved by Land Quality and DWQ.

B. During inspections the following will be observed and appropriate maintenance activities shall be performed:

1. The conformance to specifications and current condition of all erosion and sediment control structures.

2. The effectiveness and operational success of all erosion and sediment control measures.

3. The presence of sediments or other pollutants in storm water runoff at all runoff discharge points.

4. The presence of sediments or other pollutants in receiving waters.

5. Evidence of off-site tracking at all locations where vehicles enter or exit the site.

6. Evidence of impacts to water quality due to site activities pertaining to equipment operation and maintenance, material handling, and material storage and construction laydown areas exposed to precipitation.

C. Immediate action shall be taken to repair/maintain erosion and sediment control measures that are not performing as designed. The State reserves the right to stop all construction activities not related to these measures until such deficiencies are repaired.

D. In areas that have undergone final stabilization, inspections and, if necessary, maintenance by Contractor will occur at least once per month for the duration of the contract or project, whichever is longer.

3.20 MONITORING AND REPORTING

A. Monitoring: The Contractor shall be responsible for the implementation of the Inspections and Maintenance Procedures as included in the approved erosion and sediment control plan. The implementation must comply with guidelines as set forth in the NPDES General Permit Minimum Monitoring and Reporting Requirements, as well as those of any local regulatory authorities. Minimum monitoring requirements are as follows:

1. A rain gauge shall be maintained in good working order on the site.

2. A written record of the daily rainfall amounts shall be retained. (Note: if no rainfall occurred the Contractor must record "zero").

3. The control measures shall be inspected to ensure that they are operating correctly. Inspection records must be maintained for each inspection event and for each measure. All erosion and sedimentation control measures must be inspected by the Contractor at least once every seven calendar days and within 24 hours after any storm event of greater than ½ inch of rain per 24 hour period unless otherwise noted herein. Some measures require inspection following each rainfall event.

4. Once land disturbance has begun on the site, stormwater runoff discharge outfalls shall be inspected by observation for erosion, sedimentation and other stormwater discharge characteristics such as clarity, floating solids, and oil sheens. Inspections of the outfalls shall be made at least once every seven calendar days and within 24 hours after any storm event of greater than ½ inch of rain per 24 hour period. Inspection records must be maintained for each inspection event and for each discharge location.

5. If any visible sedimentation is leaving the site or entering waters of the State, corrective action shall be taken immediately to control the discharge of sediments. **Where visible deposition of sediment has occurred in surface waters or wetlands, the Contractor must verbally contact the Engineer and the Division of Water Quality within 24 hours of becoming aware of the deposition. Written notification shall be made to the Engineer and the Division of Water Quality within 5 days of becoming aware of the deposition.**

B. Reporting: The Contractor must keep a record of inspections onsite with a copy of the approved erosion and sediment control plan. Inspection records shall be made available to DWQ or its authorized agent upon request. Copies of inspection records shall be sent to the Engineer on a monthly basis. The records must provide the details of each inspection including observations and corrective actions taken as described below. The required rainfall and monitoring observations shall be recorded on an "Inspection Record for Activities Under Stormwater General Permit" form provided by DWQ or a similar inspection form that is inclusive of all of the elements contained in the Division's form. A sample inspection form can be found at the end of this Section.

1. Control Measure Inspections: Inspection records must include at a minimum: 1) identification of the measures inspected, 2) date and time of the inspection, 3)

name of the person performing the inspection, 4) indication of whether the measures were operating properly, 5) description of maintenance needs for the measure, 6) corrective actions taken and 7) date of actions taken.

2. Stormwater Discharge Inspections: Inspection records must include at a minimum: 1) identification of the discharge outfall inspected, 2) date and time of the inspection, 3) name of the person performing the inspection, 4) evidence of indicators of stormwater pollution such as oil sheen, floating or suspended solids or discoloration, 5) indication of visible sediment leaving the site, 6) actions taken to correct/prevent sedimentation and 7) date of actions taken.

3. Visible Sedimentation Found Outside the Site Limits: Inspection records must include 1) an explanation as to the actions taken to control future releases, 2) actions taken to clean up or stabilize the sediment that has left the site limits and 3) the date of actions taken.

4. Visible Sedimentation Found in Streams or Wetlands: All inspections should include evaluation of streams or wetlands onsite or offsite (where accessible) to determine if visible sedimentation has occurred.

5. Visible Stream Turbidity – If the discharge from a site results in visible stream turbidity, inspection records must record that evidence and actions taken to reduce sediment contributions.

C. The State reserves the right to use its own resources to duplicate monitoring and verify the work required by the Contractor in this section.

1. The Sedimentation Pollution Control Act requires persons responsible for land-disturbing activities to inspect a project after each phase of the project to make sure that the approved erosion and sedimentation control plan is being followed.

2. The self-inspection program is separate from the weekly self-monitoring program of the NPDES Stormwater Permit for Construction Activities. The focus of the self-inspection report is the installation and maintenance of erosion and sedimentation control measures according to the approved plan. The inspections should be conducted after each phase of the project, and continued until permanent ground cover is established.

D. Sites discharging to streams named on the state's 303(d) list as impaired for sediment-related causes may be required to perform additional monitoring, inspections or application of more stringent management practices if it is determined that the additional requirements are needed to assure compliance with the federal or state impaired-waters conditions. Inspection records must be maintained for each inspection event and for each discharge location. If a discharge covered by this permit enters a stream segment that is listed on the Impaired Stream List for sediment-related causes, and a Total Maximum Daily Load (TMDL) has been prepared for those pollutants, the Permittee must implement measures to ensure that the discharge of pollutants from the site is consistent with the assumptions and meets the requirements of the approved TMDL.

3.21 REMOVAL OF TEMPORARY SEDIMENT CONTROL STRUCTURES

A. At such time that temporary erosion and sediment control structures are no longer required under this item, the Contractor shall notify the Engineer of its intent and schedule for the removal of the temporary structures. The Contractor shall obtain the Engineer's approval in writing prior to removal. Once the Contractor has received such written approval from the Engineer, the Contractor shall remove, as approved, the temporary structures and all sediments accumulated at the removed structure shall be returned upgrade and stabilized so they do not re-erode. In areas where temporary control structures are removed, the site shall be left in a condition that will restore original drainage. Such areas shall be evenly graded and seeded as specified in Section 02910 - Final Grading and Landscaping.

- END OF SECTION -

INSPECTION RECORD
FOR ACTIVITIES UNDER STORMWATER GENERAL PERMIT

PROJECT:_____MONITORING FOR THE WEEK BEGINNING:_____

All erosion and sedimentation control measures and stormwater discharge outfalls must be inspected at least once per seven calendar days and within 24 hours after any storm event of greater than 0.5 inches of rain per 24 hour period. Permittee must keep a record of inspections onsite and send copies of inspection reports to the Engineer monthly. Inspection records must be maintained for each inspection event and for each discharge location.

RAINFALL: Gauge must be maintained on site. Record amount daily.

Day/Date	Rainfall Amount (inches)	Name Of Inspector

By this signature, I certify that this report is accurate and complete to the best of my knowledge:

_____

_____
(Signature of Permittee or Designee)
Date

CONTROL MEASURE INSPECTION: May require additional pages.

Measure Identification (i.e., silt fence, sediment pond, sediment trap, ground cover)	Date and time of inspection	Name of inspector	Operating properly? (Y/N)	Describe maintenance needs/corrective actions taken (may need to attach additional information)	Date corrective action taken

STORMWATER DISCHARGE OUTFALL INSPECTION: May require additional pages.

Stormwater Discharge Outfall Identification	Date and time of inspection	Name of inspector	Evidence of other pollutants discharging from the site (i.e., oil sheen, discoloration, cement wastes, sanitary waste, fertilizers, or fuel or material storage leakage)	Erosion seen near outfall? (Y/N)	Describe actions taken to correct/prevent sedimentation	Date corrective action taken

VISIBLE SEDIMENTATION AND/OR STREAM TURBIDITY: Any visible sedimentation observed during inspections must be recorded, corrected, and cleaned up. Take immediate corrective action to control the discharge of sediments outside the disturbed limits of the site.

Visible sedimentation found outside site limits? (Y/N) If Yes, was DWQ contacted?	Describe actions taken to control future releases and actions taken to clean up or stabilize the sediment that has left the site	Date corrective action taken	Visible sedimentation found in streams, wetlands, or buffers? (Y/N)	Describe actions taken to control future releases and actions taken to clean up or stabilize the sediment that has left the site	Date corrective action taken	Visible decrease in stream clarity (increased turbidity/cloudiness)? (Y/N)	Describe actions taken to reduce sediment contributions	Date corrective action taken

Has all land disturbing activity been completed? _____ (Y/N) Has the final permanent ground cover been completed & established? _____ (Y/N)

SELF-INSPECTION REPORT FOR LAND DISTURBING ACTIVITY AS REQUIRED

PROJECT NAME:		**PROJECT NO.:**	
NAME OF INSPECTOR:		**AFFILIATION*:**	

(*Landowner, Financially Responsible Party or Agent)

ADDRESS OF INSPECTOR:	
TELEPHONE NUMBER:	

Signature:			**Date:**
	(Landowner, Financially Responsible Party or Agent)		

Phase of Approved Erosion and Sedimentation Control Plan:

	Mark (X)
Installation of perimeter erosion and sediment control measures	
Clearing and grubbing of existing ground cover	
Completion of any phase of grading of slopes or fills	
Installation of storm drainage facilities	
Completion of construction or development	
Establishment of permanent ground cover sufficient to restrain erosion	

EROSION AND SEDIMENTATION CONTROL MEASURES INSPECTED:

Name/Number/ Location of Measure (List all measures on Plan)	**Measures Installed Since Last Report**		**Measure Operating Properly (Yes/No)**	**Significant Deviation from Plan? (Yes/No)**	**Describe Corrective Actions Needed ***
	Proposed Dimensions (feet)	**Actual Dimensions (feet)**			

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SECTION 02500

SURFACE RESTORATION

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Provide all labor, equipment, and materials necessary for final grading, topsoil placement, and miscellaneous site work not included under other Sections but required to complete the work as shown on the Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02200 - Earthwork

B. Section 02276 - Erosion and Sedimentation Control

C. Section 02910 - Final Grading and Landscaping

PART 2 -- MATERIALS

2.01 TOPSOIL

A. Topsoil shall meet the requirements of Section 02200 – Earthwork.

PART 3 -- EXECUTION

3.01 FINAL GRADING

A. Following approval of rough grading the subgrade shall be prepared as follows:

1. For riprap, bare soil 24 inches below finish grade or as directed by Engineer.

2. For topsoil, scarify 2-inches deep at 4 inches below finish grade.

3.02 TOPSOIL PLACEMENT

A. Topsoil shall be placed over all areas disturbed during construction under any contract except those areas which will be paved, graveled or rip rapped.

B. Topsoil shall be spread in place for lawn and road shoulder seed areas at a 4-inch consolidated depth and at a sufficient quantity for plant beds and backfill for shrubs and trees.

C. Topsoil shall not be placed in a frozen or muddy condition.

D. Final surface shall be hand or mechanically raked to an even finished surface to finish grade as shown on Drawings.

E. All stones and roots over 4-inches and rubbish and other deleterious materials shall be removed and disposed of.

- END OF SECTION -

SECTION 02510

PAVING AND SURFACING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish all labor, equipment and materials and perform all operations in connection with the construction of asphalt concrete pavement, asphalt concrete overlay, reinforced concrete pavement, gravel roads, concrete curb and gutter, repair and reconstruction of existing asphalt concrete pavement, repair of existing gravel roads, and pavement markings complete as specified herein and as detailed on the Drawings.

B. All new roads including the replacement of portions of the existing roads shall be to the limits, grades, thicknesses and types as shown on the Drawings. Patches for pipe crossings and areas damaged during the construction work shall be asphalt and/or gravel, depending upon the material encountered, unless otherwise indicated.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Requirements of related work are included in Division 1, Division 2 and Division 3 of these Specifications.

1.03 RELATED SECTIONS

A. Section 02200 - Earthwork

B. Section 03300 - Cast-In-Place Concrete

1.04 STANDARD SPECIFICATIONS

A. Except as otherwise provided in the Specifications or on the plans, all work shall be in accordance with the Florida Department of Transportation Standard Specifications for Road and Bridge Construction. When reference to these Specifications is intended, the description will be FDOT Section _____ or FDOT Specifications.

B. Except with the approval of the Engineer, the placing of concrete or asphalt concrete surface paving shall be subject to the Seasonal and Weather Restrictions set forth in FDOT Specifications.

PART 2 -- MATERIALS

2.01 SELECT FILL

A. The Contractor shall place select fill as necessary to complete the embankments, shoulders, subgrade foundation and replacement for removed unsuitable material in accordance with FDOT Section 120-4, and Section 02200, Earthwork.

2.02 GRAVEL

A. All work, including materials, associated with gravel shall be in accordance with FDOT specifications.

2.03 AGGREGATE STABILIZATION

A. All work, including materials, associated with Aggregate Stabilization shall be in accordance with FDOT specifications.

2.04 AGGREGATE BASE COURSE (ABC)

A. All work, including materials, associated with Aggregate Base Course shall be in accordance with FDOT specifications.

2.05 ASPHALT BINDER FOR PLANT MIX

A. All work, including materials, associated with asphalt binder shall be in accordance with FDOT specifications.

2.06 ASPHALT PAVEMENTS

A. All work, including materials, associated with asphalt pavement shall be in accordance with FDOT Standard Specifications for Road and Bridge Construction.

B. The job mix formulas shall be delivered to the Engineer at least two (2) weeks prior to beginning paving operations.

2.07 RIGID PORTLAND CEMENT CONCRETE PAVEMENT

A. All work, including materials associated with rigid concrete pavement shall be in accordance with Section 03300, Cast-In-Place Concrete. Class A concrete shall be used. Placement shall be in accordance with Section 03300 and FDOT specifications.

2.08 RIGID CONCRETE PAVEMENT REINFORCING

A. Reinforcing, if specified, shall be as shown on the Structural Drawings and as specified under Section 03200, Reinforcing Steel.

2.09 CONCRETE CURB AND GUTTERS

A. Concrete shall be Class B in accordance with the requirements of Section 03300, Cast-In-Place Concrete, except that concrete shall be air-entrained to provide an air content of 6% ± 1.5%.

B. Premolded expansion joint filler for expansion joints shall conform to ASTM D 1751 and shall be 1/2-inch thick, minimum.

2.10 ASPHALT TACK COAT

A. All work, including materials, associated with asphalt tack coat shall be in accordance with FDOT specifications.

PART 3 -- EXECUTION

3.01 EMBANKMENT

A. The embankment shall be constructed in accordance with Section 02200, Earthwork.

3.02 SUBGRADE

A. The subgrade, where shown on the Drawings, shall be aggregate stabilized by the addition and mixing of coarse aggregate with the top 3-inches of subgrade in accordance with FDOT. Aggregate stabilization shall be applied to the subgrade at a rate of 300-pounds per square yard. Following the application of stabilizer aggregate, the subgrade shall be mixed uniformly, formed true to crown and grade, and shall be compacted with a minimum of four (4) passes of a 15-ton vibratory roller to conform to the maximum densities determined by AASHTO T99 Standard Specifications.

3.03 BASE COURSE

A. The finished base course of all paving shall be ABC and shall be of the thickness shown on the Drawings, formed true to crown and grade. Gravel roads, including repair to existing gravel roads shall be ABC and shall be of the thicknesses shown on the Drawings, formed true to crown and grade. No fill material except new ABC shall be placed on top of existing gravel.

3.04 ASPHALT BASE COURSE (OR INTERMEDIATE COURSE)

A. Asphalt Concrete Base (or Intermediate) Course shall be placed in accordance with FDOT Standard Specifications for Road and Bridge Construction, Spreading and Finishing. Asphalt Concrete Base (or Intermediate) Course shall be compacted in accordance with FDOT Standard Specifications for Road and Bridge Construction, Compaction. Thicknesses shall be as shown on the Drawings.

3.05 ASPHALT CONCRETE SURFACE COURSE

A. Prior to placement of the asphalt concrete surface course, the base/intermediate course shall be inspected for damage or defects and repaired to the satisfaction of the Engineer. The surface of the base/intermediate course shall be approved by the Engineer.

B. The asphalt tack coat shall be applied to the surface of the approved base/binder course as described in FDOT Specifications. Equipment for applying the tack coat shall be power-oriented pressure spraying or distributing equipment suitable for the materials to be applied and approved by the Engineer.

C. The Asphalt Concrete Surface Course shall be placed and compacted on the base/intermediate course in layers not to exceed 2-inches and at the rate of 110-pounds per square yard per inch. Surface Course shall be compacted in accordance with FDOT. Thicknesses shall be as shown on the Drawings.

3.06 RIGID PORTLAND CEMENT CONCRETE

A. The subgrade and base course beneath portland cement concrete pavement shall be prepared in accordance with the applicable Sections of these Specifications and referenced Standard Specifications, except that the Contractor shall use an approved automatically controlled fine grading machine to produce final subgrade and base surfaces meeting the lines, grades, and cross sections (thicknesses) shown on the Drawings or established by the Engineer.

B. The surface of the base shall be damp at the time the concrete is placed. The Contractor shall sprinkle the base when necessary to provide a damp surface. The Contractor shall satisfactorily correct all soft areas in the subgrade or base prior to placing concrete.

C. Hauling over the base course shall not be allowed except where specifically permitted by and in writing by the Engineer. The Engineer may allow equipment dumping concrete to operate on the base to the extent and under the conditions the Engineer deems necessary to facilitate placing and spreading the concrete.

D. Installation of the rigid concrete pavement shall be in accordance with the details shown on the Drawings and Division 3 - Concrete. The rigid concrete pavement shall cure a minimum of ten (10) calendar days and until the concrete has attained a minimum flexural strength of 550 psi as indicated by flexural strength testing. The Contractor shall coordinate and pay for all flexural strength testing with a minimum of four (4) 6-inch by 6-inch by 20-inch beams for every fifty (50) cubic yards of pavement concrete installed.

E. Contraction joints shall be spaced at intervals as shown on the Drawings. Transverse contraction joints shall be formed by an approved joint insert. Expansion joints shall be placed when the pavement abuts a structure using 1-inch expansion joint material (filler) and sealant as specified herein.

3.07 CONCRETE CURB AND GUTTER

A. The expansion joint filler for concrete curb and gutters shall be cut to conform with the cross section of the curb. Expansion joints shall be spaced at intervals of not more than 25-feet. Formed control joints shall be installed at intervals not exceeding 10 feet. Depth of joint shall be 1/3 the thickness. Curved forms shall be used where radii are indicated; straight segments shall not be permitted. Upon removal of the forms,

exposed curb faces shall be immediately rubbed down to a smooth and uniform surface. No plastering shall be permitted.

3.08 UNDERGROUND UTILITY LINES

A. Where an underground utility line is beneath the new roadway, the backfilling shall be carried out with special care, and the final consolidation shall be accomplished by a vibratory roller. Construction of the roadway over the trench shall be deferred as long as practicable.

3.09 JUNCTION WITH OTHER PAVING

A. Where new asphalt concrete pavement abuts existing asphalt concrete pavement, the existing pavement shall be cut back to insure obtaining the specified compaction of the new pavement courses and interlocking adjoining courses. Existing subbase courses shall be cut back from the subgrade level of the new pavement on a one-on-one slope into the existing pavement, and the asphalt courses of the existing pavement shall be removed for an additional 6-inches back from the slope. The edge of the existing asphalt courses shall be saw cut straight and true. The faces between new and existing asphalt courses shall receive an application of tack coat.

B. Where new rigid concrete pavement abuts existing rigid concrete or asphalt concrete paving, the existing paving shall be saw cut straight and true. An expansion joint of a 1/2-inch minimum thickness with filler material and sealant shall be placed between the new concrete pavement and the existing rigid concrete or asphalt concrete paving.

3.10 ASPHALT CONCRETE OVERLAY

A. Where asphalt concrete is proposed to be placed over an existing asphalt or rigid concrete surface, the surfaces shall be thoroughly cleaned by power brooming and a tack coat shall be applied in accordance with FDOT, Asphalt Tack Coat, of the FDOT Standard Specifications for Road and Bridge Construction, prior to installing the overlay. The overlay shall be applied in accordance with Subsections 2.06 and 3.05 and Standard Details shown on the Drawings.

-END OF SECTION-

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SECTION 02710

STORM DRAINS AND ROOF DRAINS

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. Furnish all labor, equipment and materials in connection with the installation of exterior underground Storm drains and Roof drains as shown on the Contract Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02200 – Earthwork

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. ASTM C 76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

B. ASTM C 150 - Standard Specification for Portland Cement.

C. ASTM C 443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

D. AWWA C 110 – Standard Specification for Ductile Iron Pipe & Fittings for Water and Other Liquids.

E. ASTM C 150 – Standard Specification for Portland Cement

F. ASTM C 443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

E. AWWA C 151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.

F. ASTM D 2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and other Gravity-Flow Applications.

G. ASTM D 3350 – Standard Specifications for Polyethylene Plastic Pipe and Fitting Material.

H. ASTM F 447 – Standard Specifications for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

I. AASHTO M 198 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

J. AASHTO M 294 – Standard Specifications for Corrugated Polyethylene Pipe (12” to 36”).

K. AASHTO Section 30 – Thermoplastic Pipe.

1.04 SUBMITTALS

A. Furnish and submit shop drawings and certificates for the piping work as outlined in the General Conditions and Division 1.

B. Special care shall be exercised during delivery, distribution and storage of the pipe and fittings to prevent damage. Damaged pipe will be rejected and shall be replaced at the Contractor's expense. Storage of pipe and fittings, prior to use, shall be in such a manner as to keep the materials clean and dry.

PART 2 - PRODUCTS

2.01 REINFORCED CONCRETE PIPE (RCP) - CULVERTS

A. Pipe and Fittings

1. Reinforced concrete pipe and fittings shall conform to ASTM Standard C-76, Class III, Wall thickness B, unless otherwise noted on the Contract Drawings. All pipe shall be of the sizes indicated on the drawings. Elliptical reinforcement will not be permitted. All pipe shall be aged at the manufacturing plant for at least fourteen (14) days before delivery to the job site.

B. Joints

1. Pipe may be provided with bell and spigot or tongue and grooved ends. Pipe joints shall be made with rubber gaskets of an approved type and manufacture. Gaskets shall be of the flat or O-ring type. The design of joints and the physical requirements for rubber type gaskets shall conform to ASTM Standard C-443. Joints for the reinforced concrete culvert and drain pipe shall have bell and spigot ends with flexible plastic gaskets meeting the requirements of AASHTO M198, Type B

C. Joint Lubricant

1. Joint lubricant shall be of the type recommended by the manufacturer. Use of petroleum-based lubricants is not permitted.

2.02 Ductile Iron Pipe (DIP) - Roof Drains

A. Pipe

1. Shall be centrifugally cast in metal molds or sand lined molds in accordance with ANSI A21.51 (AWWA C151) of grade 70-50-05 ductile iron. The above standard covers ductile iron pipe with nominal pipe sizes from three (3) inches up to and including fifty-four (54) inches in diameter.

2. Shall have a rated working pressure of 150 psi.

3. Shall be a minimum PC 150.

B. Fittings

1. Shall be manufactured in accordance with ANSI A21.10 (AWWA C110).

2. Shall be manufactured of grade 70 - 50 - 05 ductile iron.

3. Shall have a rated working pressure of 250 psi.

4. Grey iron fittings which conform to the specifications contained herein may be used with ductile iron pipe providing the piping systems minimum working pressure is met or exceeded, and only where ductile iron fittings are not manufactured for a specific fitting.

C. Coatings and Linings for Pipe and Fittings

1. The standard asphaltic coating shall be applied to the exterior wall of the pipe and fittings in accordance with ANSI A21.51 (AWWA C151).

2. The pipe and fittings shall be cement mortar lined to twice the standard thickness in accordance with ANSI A21.4 (AWWA C104) except as specified in the pipe schedule. A seal coat of asphaltic material shall be applied to the mortar lining.

D. Joints

1. Joints shall be push on type in accordance with ANSI A21.11 (AWWA CIII).

2.03 SMOOTH LINED CORRUGATED POLYETHYLENE PIPE - STORM DRAINS

A. General

1. Smooth lined corrugated polyethylene pipe shall be used for storm drains and shall be BLUE SEAL watertight HDPE pipe as manufactured by Hancor, Inc., N-12 WT IB (Watertight) Pipe by ADS, Inc., or approved equal.

B. Pipe and Fittings

1. Smooth lined corrugated polyethylene pipe and fittings shall conform to AASHTO M252-TYPE S for 4" to 10"φ and AASHTO M294 - TYPE S for 12" to 36"φ. All pipes shall be of the sizes indicated on the drawings.

C. Joints

1. Joints shall be watertight bell and spigot type; Hancor, Inc. BLUE SEAL, ADS, Inc. N-12 WT IB, or equal.

D. Foundation Drains

1. Foundation drains shall conform to AASHTO M252-TYPE C. Drains shall have drilled perforations and be Heavy Duty-AASHTO Pipe as manufactured by Hancor, Inc., Single Wall Corrugate Pipe by ADS, Inc., or approved equal.

2.04 BACKFILL MATERIAL

A. Locally available materials shall be used for pipe backfill if Contractor demonstrates the soils meet one of the acceptable soil classifications outlined in Table 1. Imported materials meeting the criteria of Table 1 may also be used.

TABLE 1 – ACCEPTABLE BACKFILL MATERIAL AND COMPACTION REQUIREMENTS

SOIL CLASSIFICATIONS				
DESCRIPTION	ASTM D 2321	ASTM D 2487	AASHTO M 43	Minimum Standard Proctor Density %
Graded or crushed, crushed stone, gravel	Class I	--	5 56	Dumped
Well-graded sand, gravels and gravel/sand mixtures, poorly graded sand, gravels and gravel/sand mixtures; little or no fines	Class II	GW GP SW SP	57 6	95%
Silty or clayey gravels, gravel/sand/silt or gravel and clay mixtures; silty or clayey sands, sand/clay or sand/silt mixtures	Class III	GM GC SM SC	Gravel and Sand (<10% fines)	95%

PART 3 – EXECUTION

3.01 INSPECTION

A. Each length of pipe and fittings delivered to the property shall be inspected by the Contractor, in the presence of the Engineer, for flaws, cracks, dimensional tolerances and compliance with the referenced Standards. The Contractor shall provide the Engineer with suitable templates or calipers for checking pipe dimensions. Only lengths of pipe and fittings accepted by the Engineer and so marked may be installed in the work.

3.02 INSTALLATION

A. Trenching, bedding and backfilling shall be as specified in Section 02200 - Earthwork of these Specifications and Section 2.04 Backfill Material of this Specification. Under no condition shall pipe be laid in water or when trench conditions or weather are unsuitable for such work.

B. All pipes and fittings shall be handled carefully in loading and unloading. They shall be lifted by hoists or lowered on skidways in such a manner as to avoid shock. Derricks, ropes or other suitable equipment shall be used for lowering the pipe into the trench. Pipe and fittings shall not be dropped or dumped.

C. Each pipe and fitting shall be inspected before it is lowered into the trench. The interior of the pipe and all joint surfaces shall be thoroughly cleaned and shall thereafter be maintained clean. The open ends of pipe shall be securely plugged whenever pipe laying is not in progress.

D. Pipe and fittings shall be selected so that there will be as small a deviation as possible at the joints and so that inverts present a smooth surface. All joints shall be installed, made up and inspected in accordance with approved printed instructions of the manufacturer. Pipe and fittings which do not fit together to form a tight joint will be rejected.

E. Cutting of reinforced concrete pipe will be permitted only at connections to structures and be accomplished by abrasive saws. Cutting of other pipe materials shall be done only with mechanical cutters and in accordance with the manufacturer's recommendations.

F. Pipe shall be laid accurately to the lines and grades shown on the drawings or as directed by the Engineer.

G. If an adequate foundation for the pipe is not available at the desired depth, additional excavation shall be required and the foundation brought to desired grade with suitable granular material.

H. Rock outcroppings, very soft soils such as muck, and other similar materials not providing proper foundation support shall be removed/replaced with suitable granular material.

I. Bedding material directly under the pipe invert shall be left in native condition and not compacted. Pipe shall be placed on the bedding, then backfilled under the pipe haunches before further backfill is placed.

J. Class I materials may be dumped around pipe. Voids shall be eliminated by knifing under and around the pipe or by other approved technique.

L. Inorganic silts, and gravelly, sandy, or silty clays, and other Class IV materials (not shown in Table 1) shall not be used for pipe backfill.

M. Any section of the pipe that is found defective in material, alignment, grade, joints, or otherwise, shall be satisfactorily corrected by the Contractor at no additional cost to the Owner.

3.03 COMPACTION

A. General

1. Place and assure backfill and fill materials achieve an equal or higher degree of compaction than undisturbed materials adjacent to the work.

2. In no case shall degree of compaction below “Minimum Compactions” specified be accepted.

B. Compaction Requirements: Unless noted otherwise on the Drawings or more stringently by other sections of these Specifications, comply with following trench compaction criteria:

TABLE 2 – - MINIMUM COMPACTIONS

LOCATION	SOIL TYPE	DENSITY
1. Compacted select backfill:		
All applicable areas	Cohesive soil	95 percent of maximum dry density by ASTM D698
	Cohensionless soils	75 percent of maximum relative density by ASTM D4253 and ASTM D4254
2. Common trench backfill:		
Under pavements roadways surfaces, D698 within highway right-of-ways, adjacent to retaining walls	Cohesive soils	95 percent of maximum dry density by ASTM D698
	Cohensionless soils	75 percent of maximum relative density by ASTM D4253 and ASTM D4254
Under turfed, sodded plant seeded, non-traffic areas	Cohesive soils	95 percent of maximum dry density by ASTM D698
	Cohensionless soils	75 percent of maximum relative density by ASTM D4253 and ASTM D4254

C. Ensure backfill materials have moisture content within three (3) percent of optimum moisture content at the time of placement.

3.04 TESTING

A. General

1. The Contractor shall provide at his own expense, all labor, material, measuring devices and water necessary to perform the required tests. All tests shall be performed in the presence of the Engineer. Disposal of water shall be in accordance with Section 01010.

B. Tests by Manufacturer

1. An infiltration and exfiltration test for the pipe shall be made at the place of manufacture. Certified test results shall be submitted. The infiltration or exfiltration allowance shall not exceed 250 gallons per inch of pipe diameter per mile per day. One joint test for each two hundred feet of pipe to be furnished.

C. Exfiltration and Infiltration Tests

1. The pipe shall be tested for leakage by exfiltration and/or infiltration tests after installation and back-filling. Exfiltration or infiltration shall not exceed 250 gallons per inch of pipe diameter per mile per day. If the leakage is greater than that volume allowed, the Contractor shall locate and repair or replace defective joints or pipes at his expense until the leakage is within the specified allowance.

2. Exfiltration tests shall be performed on all pipe where the ground- water elevation is one foot above the crown of the pipe or less. Exfiltration tests shall impose a head of at least 2 feet on the pipe at the maximum elevation of the length to be tested. An allowance of an additional 10 percent of gallonage shall be permitted for each additional 2 feet of head over the initial 2 foot minimum. Infiltration tests shall be performed for all other pipe where the groundwater table is greater than one foot above the crown of the pipe.

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SECTION 02623

HIGHWAY RATED (H20) CORRUGATED HIGH DENSITY POLYETHYLENE (HDPE) DRAINAGE PIPE AND POLYVINYL CHLORIDE (PVC) DRAIN BASINS

PART 1 – GENERAL

1.01 SUMMARY

A. Contractor shall furnish all labor, materials, equipment and incidentals required to design and install corrugated high-density polyethylene drainage pipe, fittings and appurtenances.

1.02 SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with Section 01300.

1.03 REFERENCES STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM D1238 – Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.

2. ASTM D 2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Application (latest edition)

3. ASTM F2648 - Standard Specification for 2 to 60 inch Annular Corrugated Profile Wall Polyethylene (PE) Pipe and Fittings for Land Drainage Applications (latest edition)

4. ASTM F477 - Standard Specification for elastomeric seals (gaskets) for joining plastic pipe (latest edition)

5. ASTM F 2306 - Standard Specification for 12 to 60-inch Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications (latest edition)

6. ASTM D1248 – Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.

7. ASTM D1505 – Standard Test Method for Density of Plastics by the Density-Gradient Technique.

8. ASTM D3350 – Standard Specification for Polyethylene Plastic Pipe and Fittings Materials.

9. ASTM F714 – Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.

10. American National Standards Institute (ANSI)

11. Institute of Electrical and Electronics Engineers (IEEE)

12. American Society for Testing and Materials (ASTM)

13. National Fire Protection Association (NEPA)

14. National Electric Code (NEC)

15. Factory Mutual (FM)

16. Underwriters Laboratories (UL)

17. National Electrical Manufacturers Association (NEMA)

18. Occupational Safety and Health Administration (OSHA)

19. HDPE pipe manufacturers' installation guidelines.

PART 2 – PRODUCTS

2.01 CORRUGATED HIGH DENSITY POLYETHYLENE (HDPE) PIPE

A. Corrugated HDPE pipe shall have an annular corrugated exterior, smooth inner wall and built-in bell and spigot joints.

B. High Density Polyethylene (HDPE) Pipe resins shall be high molecular weight, high density polyethylene with a cell classification number of 345434C in accordance with ASTM D3350.

C. All polyethylene pipe shall meet the requirements of AST F714.

D. The Corrugated HDPE pipe and appurtenances shall be high density polyethylene all manufactured by the same company and shall meet or exceed the ASTM F2648 specifications.

E. Backfilling over the pipe shall be to the pipe manufacturer's specifications. Cover shall be compacted to at least 92 percent of its maximum dry density as determined by ASTM Test D1557, Method D.

2.02 PIPE IDENTIFICATION

A. The following shall be printed on the pipe and spaced at intervals not exceeding 5-ft:

1. Name and/or trademark of the pipe manufacturer.
2. Nominal pipe size.
3. Dimension ratio.
4. The letters PE followed by the polyethylene grade in accordance with ASTM D1248, followed by the hydrostatic design basis in 100's of psi, e.g., PE 3408.
5. Manufacturing standard reference, e.g., ASTM F714.
6. A production code from which the date and place of manufacture can be determined.

2.03 PIPE JOINTS

A. All joints shall be a soil-tight joint meeting ASTM F477. Soil-tight bell and spigot joints will utilize an elastomeric rubber gasket that shall meet ASTM F2648.

2.04 PIPE FITTINGS

A. Pipe fittings shall conform to ASTM F2306. Bell and spigot shall utilize a spun-on or welded bell and valley or saddle gasket meeting the soil-tight performance requirements of ASTM F2306

2.05 PVC DRAIN BASINS

A. The drain basins required for this contract shall be manufactured from PVC stock, utilizing a thermoforming process to reform the pipe stock to the specified configuration.

B. The drainage pipe connection stubs shall be manufactured from PVC stock and formed to provide a watertight connection with the specified pipe system.

C. This joint shall conform to ASTM D3212 for joints for drain and sewer plastic pipe using flexible elastomeric seals. The flexible elastomeric seals shall conform to ASTM F477.

D. The pipe bell spigot shall be joined to the main body of the drain basin or catch basin.

E. The raw material used to manufacture the pipe stock that is used to manufacture the main body and pipe stubs of the surface drainage inlets shall conform to ASTM D1784 cell class 12454.

F. The grates and frames furnished for all surface drainage inlets shall be ductile iron and shall be made specifically for each basin so as to provide a round bottom flange that closely matches the diameter of the surface drainage inlet.

G. Grates for drain basins shall be capable of supporting various wheel loads as specified.

H. Ductile iron used in the manufacture of the castings shall conform to ASTMA536 grade 70-50-05.

I. Grates and covers shall be provided painted black.

PART 3– INSTALLATION

A. The specified PVC surface drainage inlets shall be installed using conventional flexible pipe backfill materials and procedures. The backfill shall be crushed stone or other granular material meeting the requirements of class1, class 2, or class 3 material as defined in ASTM D2321. Bedding and backfill for surface drainage inlets shall be placed and compacted uniformly in accordance with ASTM D2321. The drain basin body will be cut at the time of the final grade. No brick, stone or concrete block will be required to set the grate to the final height. For load rated installations, an 8" minimum thickness concrete slab shall be poured under and around the grate and frame. The concrete slab must be designed taking into consideration local soil conditions, traffic loading, and other applicable design factors.

- END OF SECTION -

DIVISION 3

Concrete

SECTION 03100

CONCRETE FORMWORK

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Provide materials, labor, and equipment required for the design and construction of all concrete formwork, bracing, shoring and supports in accordance with the provisions of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03200 - Reinforcing Steel

B. Section 03250 - Concrete Accessories

C. Section 03290 - Joints in Concrete

D. Section 03300 - Cast-in-Place Concrete

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Building Code 6th Edition (2017)

2. ACI 318 - Building Code Requirements for Structural Concrete

3. ACI 301 - Specifications for Structural Concrete for Buildings

4. ACI 347 - Recommended Practice for Concrete Formwork

5. U.S. Product Standard for Concrete Forms, Class I, PS 1

6. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01300, Submittals.

1. Manufacturer's data on proposed form release agent

2. Manufacturer's data on proposed formwork system including form ties

1.05 QUALITY ASSURANCE

A. Concrete formwork shall be in accordance with ACI 301, ACI 318, and ACI 347.

PART 2 -- PRODUCTS

2.01 FORMS AND FALSEWORK

A. All forms shall be smooth surface forms unless otherwise specified.

B. Wood materials for concrete forms and falsework shall conform to the following requirements:

1. Lumber for bracing, shoring, or supporting forms shall be Douglas Fir or Southern Pine, construction grade or better, in conformance with U.S. Product Standard PS20. All lumber used for forms, shoring or bracing shall be new material.

2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Pine high density overlaid (HDO) plywood manufactured especially for concrete formwork and shall conform to the requirements of PS1 for Concrete Forms, Class I, and shall be edge sealed. Thickness shall be as required to support concrete at the rate it is placed, but not less than 5/8-inch thick.

C. Other form materials such as metal, fiberglass, or other acceptable material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line and grade indicated may be submitted to the Engineer for approval, but only materials that will produce a smooth form finish equal or better than the wood materials specified will be considered.

2.02 FORMWORK ACCESSORIES

A. Form ties shall be provided with a plastic cone or other suitable means for forming a conical hole to insure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties, or of other removable form-tie fasteners having a circular cross-section, shall not exceed 7/8-inch, and all such fasteners shall be such as to leave holes of regular shape for reaming.

B. Form ties for water-retaining structures shall have integral waterstops. Removable taper ties may be used when acceptable to the Engineer. A preformed mechanical EPDM rubber plug shall be used to seal the hole left after the removal of the taper tie. Plug shall be X-Plug by the Greenstreak Group, Inc., or approved equal. Friction fit plugs shall not be used.

C. Form release agent shall be a blend of natural and synthetic chemicals that employs a chemical reaction to provide quick, easy and clean release of concrete from forms. It shall not stain the concrete and shall leave the concrete with a paintable surface. Formulation of

the form release agent shall be such that it would minimize formation of "bug holes" in cast-in-place concrete.

PART 3 -- EXECUTION

3.01 FORM DESIGN

A. Forms and falsework shall be designed for total dead load, plus all construction live load as outlined in ACI 347. Design and engineering of formwork and safety considerations during construction shall be the responsibility of the Contractor.

B. Forms shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. The maximum deflection of facing materials reflected in concrete surfaces exposed to view shall be 1/240 of the span between structural members.

C. All forms shall be designed for predetermined placing rates per hour, considering expected air temperatures and setting rates.

3.02 CONSTRUCTION

A. The type, size, quality, and strength of all materials from which forms are made shall be subject to the approval of the Engineer. No falsework or forms shall be used which are not clean and suitable. Deformed, broken or defective falsework and forms shall be removed from the work.

B. Forms shall be smooth and free from surface irregularities. Suitable and effective means shall be provided on all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. Joints between the forms shall be sealed to eliminate any irregularities. The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to a practical minimum.

C. Forms shall be true to line and grade and shall be sufficiently rigid to prevent displacement and sagging between supports. Curved forms shall be used for curved and circular structures. Straight panels joined at angles will not be acceptable for forming curved structures. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly-placed concrete. Facing material shall be supported with studs or other backing which shall prevent both visible deflection marks in the concrete and deflections beyond the tolerances specified.

D. Forms shall be mortar tight so as to prevent the loss of water, cement and fines during placing and vibrating of the concrete. Specifically, the bottom of wall forms that rest on concrete footings or slabs shall be provided with a gasket to prevent loss of fines and paste during placement and vibration of concrete. Such gasket may be a 1 to 1½ inch diameter polyethylene rod held in position to the underside of the wall form.

E. All vertical surfaces of concrete members shall be formed, and side forms shall be provided for all footings, slab edges and grade beams, except where placement of the concrete

against the ground is called for on the Drawings. Not less than 1-inch of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.

F. All forms shall be constructed in such a manner that they can be removed without hammering or prying against the concrete. Wood forms shall be constructed for wall openings to facilitate loosening and to counteract swelling of the forms.

G. Adequate clean-out holes shall be provided at the bottom of each lift of forms. Temporary openings shall be provided at the base of column forms and wall forms and at other points to facilitate cleaning and observation immediately before the concrete is deposited. The size, number and location of such clean-outs shall be as acceptable to the Engineer.

H. Construction joints shall not be permitted at locations other than those shown or specified, except as may be acceptable to the Engineer. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete. For flush surfaces at construction joints exposed to view, the contact surface of the form sheathing over the hardened concrete in the previous placement shall be lapped by not more than 1 inch. Forms shall be held against hardened concrete to prevent offset or loss of mortar at construction joints and to maintain a true surface.

I. The formwork shall be cambered to compensate for anticipated deflections in the formwork due to the weight and pressure of the fresh concrete and due to construction loads. Set forms and intermediate screed strips for slabs accurately to produce the designated elevations and contours of the finished surface. Ensure that edge forms and screed strips are sufficiently strong to support vibrating screeds or roller pipe screeds if the nature of the finish specified requires the use of such equipment. When formwork is cambered, set screeds to a like camber to maintain the proper concrete thickness.

J. Positive means of adjustment (wedges or jacks) for shores and struts shall be provided and all settlement shall be taken up during concrete placing operation. Shores and struts shall be securely braced against lateral deflections. Wedges shall be fastened firmly in place after final adjustment of forms prior to concrete placement. Formwork shall be anchored to shores or other supporting surfaces or members to prevent upward or lateral movement of any part of the formwork system during concrete placement. If adequate foundation for shores cannot be secured, trussed supports shall be provided.

K. Runways shall be provided for moving equipment with struts or legs. Runways shall be supported directly on the formwork or structural member without resting on the reinforcing steel.

3.03 TOLERANCES

A. Unless otherwise indicated in the Contract Documents, formwork shall be constructed so that the concrete surfaces will conform to the tolerance limits listed in ACI 117.

B. Structural framing of reinforced concrete around elevators and stairways shall be accurately plumbed and located within 1/4 in. tolerance from established dimensions.

C. The Contractor shall establish and maintain in an undisturbed condition and until final completion and acceptance of the project, sufficient control points and bench marks to be used for reference purposes to check tolerances. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by Contractor's personnel and by the Engineer and shall be in sufficient number and properly installed. During concrete placement, the Contractor shall continually monitor plumb and string line form positions and immediately correct deficiencies.

D. Regardless of the tolerances specified, no portion of the building shall extend beyond the legal boundary of the building.

3.04 FORM ACCESSORIES

A. Suitable moldings shall be placed to bevel or round all exposed corners and edges of beams, columns, walls, slabs, and equipment pads. Chamfers shall be 3/4 inch unless otherwise noted.

B. Form ties shall be so constructed that the ends, or end fasteners, can be removed without causing appreciable spalling at the faces of the concrete. After ends, or end fasteners of form ties have been removed, the embedded portion of the ties shall terminate not less than 2 inches from the formed face of the concrete that is exposed to water or enclosed surfaces above the water surface, and not less than 1 inch from the formed face of all other concrete. Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with mortar as specified in Section 03350 - Concrete Finishing. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete member. The use of snap-ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted. No snap ties shall be broken off until the concrete is at least three days old. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste.

3.05 APPLICATION - FORM RELEASE AGENT

A. Forms for concrete surfaces that will not be subsequently waterproofed shall be coated with a form release agent. Form release agent shall be applied on formwork in accordance with manufacturer's recommendations.

3.06 INSERTS AND EMBEDDED ITEMS

A. Sleeves, pipe stubs, inserts, anchors, expansion joint material, waterstops, and other embedded items shall be positioned accurately and supported against displacement prior to concreting. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids.

3.07 FORM CLEANING AND REUSE

A. The inner faces of all forms shall be thoroughly cleaned prior to concreting. Forms may be reused only if in good condition and only if acceptable to the Engineer. Light sanding between uses will be required wherever necessary to obtain uniform surface texture. Unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the Engineer.

3.08 FORM REMOVAL AND SHORING

A. Forms shall not be disturbed until the concrete has attained sufficient strength. Sufficient strength shall be demonstrated by structural analysis considering proposed loads, strength of forming and shoring system, and concrete strength data. Shoring shall not be removed until the supported member has acquired sufficient strength to support its weight and the load upon it. Members subject to additional loads during construction shall be adequately shored to sustain all resulting stresses. Forms shall be removed in such manner as not to impair safety and serviceability of the structure. All concrete to be exposed by form removal shall have sufficient strength not to be damaged thereby.

B. Provided the strength requirements specified above have been met and subject to the Engineer's approval, forms may be removed at the following minimum times. The Contractor shall assume full responsibility for the strength of all such components from which forms are removed prior to the concrete attaining its full design compressive strength. Shoring may be required at the option of the Engineer beyond these periods.

Ambient Temperature (°F.) During Concrete Placement

	Over 95°	70°-95°	60°-70°	50°-60°	Below 50°
Walls	5 days	2 days	2 days	3 days	Do not remove until directed by Engineer (7 days minimum)
Columns	7 days	2 days	3 days	4 days	
Beam Soffits	10 days	7 days	7 days	7 days	
Elevated Slabs	12 days	7 days	7 days	7 days	

C. When, in the opinion of the Engineer, conditions of the work or weather justify, forms may be required to remain in place for longer periods of time.

D. An accurate record shall be maintained by the Contractor of the dates of concrete placings and the exact location thereof and the dates of removal of forms. These records shall be available for inspection at all times at the site, and two copies shall be furnished the Engineer upon completion of the concrete work.

3.09 RESHORING

A. When reshoring is permitted or required the operations shall be planned in advance and subjected to approval by the Engineer.

B. Reshores shall be placed after stripping operations are complete but in no case later than the end of the working day on which stripping occurs.

C. Reshoring for the purpose of early form removal shall be performed so that at no time will large areas of new construction be required to support their own weight. While reshoring is under way, no construction or live loads shall be permitted on the new construction. Reshores shall be tightened to carry their required loads but they shall not be overtightened so that the new construction is overstressed. Reshores shall remain in place until the concrete has reached its specified 28-day strength, unless otherwise specified.

D. For floors supporting shores under newly placed concrete, the original supporting shores shall remain in place or reshores shall be placed. The shoring or reshoring system shall have a capacity sufficient to resist the anticipated loads and in all cases shall have a capacity equal to at least one-half of the capacity of the shoring system above. Reshores shall be located directly under a reshore position above unless other locations are permitted.

E. In multi-story buildings, reshoring shall extend over a sufficient number of stories to distribute the weight of newly placed concrete, forms, and construction live loads so the design superimposed loads of the floors supporting shores are not exceeded.

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SECTION 03200

REINFORCING STEEL

PART 1 -- GENERAL

1.01 THE REQUIREMENTS

A. Provide all concrete reinforcing including all cutting, bending, fastening and any special work necessary to hold the reinforcing steel in place and protect it from injury and corrosion in accordance with the requirements of this section.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03100 - Concrete Formwork

C. Section 03250 - Concrete Accessories

D. Section 03300 - Cast-in-Place Concrete

E. Section 03400 - Precast Concrete

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Building Code 6th Edition (2017)

2. CRSI - Concrete Reinforcing Institute Manual of Standard Practice

3. ACI SP66 - ACI Detailing Manual

4. ACI 315 - Details and Detailing of Concrete Reinforcing

5. ACI 318 - Building Code Requirements for Structural Concrete

6. ICC-ES AC193 Acceptance Criteria for Expansion and Screw Anchors (Concrete)

7. WRI - Manual of Standard Practice for Welded Wire Fabric

8. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcing

9. ASTM A 1064 - Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01300, Submittals.

1. Detailed placing and shop fabricating drawings, prepared in accordance with ACI 315 and ACI Detailing Manual - (SP66), shall be furnished for all concrete reinforcing. These drawings shall be made to such a scale as to clearly show joint locations, openings, and the arrangement, spacing and splicing of the bars.

2. Mill test certificates - 3 copies of each.

3. Description of the reinforcing steel manufacturer's marking pattern.

4. Requests to relocate any bars that cause interferences or that cause placing tolerances to be violated.

5. Proposed supports for each type of reinforcing.

6. Request to use splices not shown on the Drawings.

7. Request to use mechanical couplers along with manufacturer's literature on mechanical couplers with instructions for installation, and certified test reports on the couplers' capacity.

8. Request for placement of column dowels without the use of templates.

9. Request and procedure to field bend or straighten partially embedded reinforcing.

10. International Code Council–Evaluation Services Report (ICC-ES ESR) for dowel adhesives.

11. Certification that all installers of dowel adhesive are certified as Adhesive Anchor Installers in accordance with the ACI-CRSI Anchor Installer Certification Program.

12 Adhesive dowel testing plan.

1.05 QUALITY ASSURANCE

A. If requested by the Engineer, the Contractor shall provide samples from each load of reinforcing steel delivered in a quantity adequate for testing. Costs of initial tests will be paid by the County. Costs of additional tests due to material failing initial tests shall be paid by the Contractor.

B. Provide a list of names of all installers who are trained by the Manufacturer’s Field Representative on this jobsite prior to installation of products. Record must include the installer name, date of training, products included in the training and trainer name and contact information.

C. Provide a copy of the current ACI/CRSI “Adhesive Anchor Installer” certification cards for all installers who will be installing adhesive anchors in the horizontal to vertically overhead orientation.

D. Inspections of the adhesive dowel system may be made by the Engineer or other representatives of the Owner in accordance with the requirements of the ESR published by the manufacturer. Provide adequate time and access for inspections of products and anchor holes prior to injection, installation, and proof testing.

PART 2 -- PRODUCTS

2.01 REINFORCING STEEL

A. Bar reinforcing shall conform to the requirements of ASTM A 615 for Grade 60 Billet Steel reinforcing. All reinforcing steel shall be from domestic mills and shall have the manufacturer's mill marking rolled into the bar which shall indicate the producer, size, type and grade. All reinforcing bars shall be deformed bars. Smooth reinforcing bars shall not be used unless specifically called for on Drawings.

B. Welded wire fabric reinforcing shall conform to the requirements of ASTM A 1064 and the details shown on the Drawings.

C. A certified copy of the mill test on each load of reinforcing steel delivered showing physical and chemical analysis shall be provided, prior to shipment. The Engineer reserves the right to require the Contractor to obtain separate test results from an independent testing laboratory in the event of any questionable steel. When such tests are necessary because of failure to comply with this Specification, such as improper identification, the cost of such tests shall be borne by the Contractor.

D. Field welding of reinforcing steel will not be allowed.

E. Use of coiled reinforcing steel will not be allowed.

2.02 ACCESSORIES

A. Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers and other devices to position reinforcing during concrete placement. Wire bar supports shall be plastic protected (CRSI Class 1).

B. Concrete blocks (dobies), used to support and position bottom reinforcing steel, shall have the same or higher compressive strength as specified for the concrete in which it is located.

2.03 MECHANICAL COUPLERS

A. Mechanical couplers shall develop a tensile strength which exceeds 100 percent of the ultimate tensile strength and 125 percent of the yield strength of the reinforcing bars being spliced. The reinforcing steel and coupler used shall be compatible for obtaining the required strength of the connection.

B. Where the type of coupler used is composed of more than one component, all components required for a complete splice shall be supplied.

C. Hot forged sleeve type couplers shall not be used. Acceptable mechanical couplers are Dayton Superior Dowel Bar Splicer System by Dayton Superior, Dayton, Ohio, or approved equal. Mechanical couplers shall only be used where shown on the Drawings or where specifically approved by the Engineer.

D. Where the threaded rebar to be inserted into the coupler reduces the diameter of the bar, the threaded rebar piece shall be provided by the coupler manufacturer.

2.04 DOWEL ADHESIVE SYSTEM

A. Where shown on the Drawings, reinforcing bars anchored into hardened concrete with a dowel adhesive system shall use a two-component adhesive mix which shall be injected with a static mixing nozzle following manufacturer's instructions.

B. All holes shall be drilled in accordance with the manufacturer's instructions except that core drilled holes shall not be permitted unless specifically allowed by the Engineer. Cored holes, if allowed by the manufacturer and approved by the Engineer, shall be roughened in accordance with manufacturer's requirements.

C. Thoroughly clean drill holes of all debris, drill dust, and water in accordance with manufacturer's instructions prior to installation of adhesive and reinforcing bar.

D. Degree of hole dampness shall be in strict accordance with manufacturer recommendations. Installation conditions shall be either dry or water-saturated. Water filled or submerged holes shall not be permitted unless specifically approved by the Engineer.

E. Injection of adhesive into the hole shall be performed in a manner to minimize the formation of air pockets in accordance with the manufacturer's instructions.

F. Embedment Depth:

1. The embedment depth of the bar shall be as shown on the Drawings. If the Contractor submits one of the other named dowel adhesives from the list below, the Engineer shall evaluate the required embedment and the Contractor shall provide the required embedment depth stipulated by the Engineer specific to the approved dowel adhesive.

2. Where the embedment depth is not shown on the Drawings, the embedment depth shall be determined to provide the minimum allowable bond strength equal to the tensile strength of the rebar according to the manufacturer's ICC-ES ESR.

3. The embedment depth shall be determined using the actual concrete compressive strength, a cracked concrete state, maximum long term temperature of 110 degrees F, and maximum short term temperature of 140 degrees F. In no case shall the embedment depth be less than the minimum, or more than the maximum, embedment depths stated in the manufacturer's ICC-ES ESR.

G. Engineer's approval is required for use of this system in locations other than those shown on the Drawings.

H. The adhesive system shall be IBC compliant for use in both cracked and uncracked concrete in all Seismic Design Categories and shall be "Epcon C6+ Adhesive Anchoring System" as manufactured by ITW Redhead, " HIT-HY 200 Adhesive Anchoring System" as manufactured by Hilti, Inc. “SET-XP Epoxy Adhesive Anchors” as manufactured by Simpson Strong-Tie Co. or “Pure 110+ Epoxy Adhesive Anchor System” by DeWalt. Fast-set epoxy formulations shall not be acceptable. No or equal products will be considered, unless pre-qualified and approved.

I. All individuals installing dowel adhesive system shall be certified as an Adhesive Anchor Installer in accordance with the ACI-CRSI Anchor Installation Certification Program.

PART 3 – EXECUTION

3.01 TEMPERATURE REINFORCING

A. Unless otherwise shown on the Drawings or in the absence of the concrete reinforcing being shown, the minimum cross sectional area of horizontal and vertical concrete reinforcing in walls shall be 0.0033 times the gross concrete area and the minimum cross sectional area of reinforcing perpendicular to the principal reinforcing in slabs shall be 0.0020 times the gross concrete area. Temperature reinforcing shall not be spaced further apart than five times the slab or wall thickness, nor more than 18 inches.

3.02 FABRICATION

A. Reinforcing steel shall be accurately formed to the dimensions and shapes shown on the Drawings and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as modified by the Drawings.

B. The Contractor shall fabricate reinforcing bars for structures in accordance with the bending diagrams, placing lists and placing Drawings.

C. No fabrication shall commence until approval of Shop Drawings has been obtained. All reinforcing bars shall be shop fabricated unless approved to be bent in the field. Reinforcing bars shall not be straightened or rebent in a manner that will injure the material. Heating of bars will not be permitted.

D. Welded wire fabric with longitudinal wire of W9.5 size or smaller shall be either furnished in flat sheets or in rolls with a core diameter of not less than 10 inches. Welded wire fabric with longitudinal wires larger than W9.5 size shall be furnished in flat sheets only.

3.03 DELIVERY, STORAGE AND HANDLING

A. All reinforcing shall be neatly bundled and tagged for placement when delivered to the job site. Bundles shall be properly identified for coordination with mill test reports.

B. Reinforcing steel shall be stored above ground on platforms or other supports and shall be protected from the weather at all times by suitable covering. It shall be stored in an orderly manner and plainly marked to facilitate identification.

C. Reinforcing steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.

D. The surfaces of all reinforcing steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcing shall be reinspected and if necessary recleaned.

3.04 PLACING

A. Reinforcing steel shall be accurately positioned as shown on the Drawings and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcing steel shall be supported by concrete, plastic or plastic protected (CRSI Class 1) metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcing steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used in sufficient numbers to support the reinforcing bars without settlement. In no case shall concrete block supports be continuous.

B. The portions of all accessories in contact with the formwork shall be made of plastic or steel coated with a 1/8 inch minimum thickness of plastic which extends at least 1/2 inch from the concrete surface. Plastic shall be gray in color.

C. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.

D. Reinforcing bars additional to those shown on the Drawings, which may be found necessary or desirable by the Contractor for the purpose of securing reinforcing in position, shall be provided by the Contractor at no additional cost to the County.

E. Reinforcing placing, spacing, and protection tolerances shall be within the limits specified in ACI 318 except where in conflict with the Building Code, unless otherwise specified.

F. Reinforcing bars may be moved within one bar diameter as necessary to avoid interference with other concrete reinforcing, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed placing tolerances, the resulting arrangement of bars shall be as acceptable to the Engineer.

G. Welded wire fabric shall be supported on slab bolsters spaced not less than 30 inches on centers, extending continuously across the entire width of the reinforcing mat and supporting the reinforcing mat in the plane shown on the Drawings.

H. Reinforcing shall not be straightened or rebent unless specifically shown on the drawings. Bars with kinks or bends not shown on the Drawings shall not be used. Coiled reinforcement shall not be used.

I. Dowel Adhesive System shall be installed in strict conformance with the manufacturer's recommendations and as required in Article 2.04 above. A representative of the manufacturer must be on site prior to adhesive dowel installation to provide instruction on proper installation procedures for all adhesive dowel installers. Testing of adhesive dowels shall be as indicated below. If the dowels have a hook at the end to be embedded in subsequent work, an approved mechanical coupler shall be provided at a convenient distance from the face of existing concrete to facilitate adhesive dowel testing while maintaining required hook embedment in subsequent work.

J. All adhesive dowel installations in the horizontal or overhead orientation shall be conducted by a certified Adhesive Anchor Installer as certified by ACI/CSRI per ACI 318-11 9.2.2. Current AAI Certificated must be submitted to the Engineer of Record for approval prior to commencement of any adhesive anchor installations.

K. Adhesive Dowel Testing

1. At all locations where adhesive dowels are shown on the Drawings, at least 25 percent of all adhesive dowels installed shall be tested to the value indicated on the Drawings, with a minimum of one tested dowel per group. If no test value is indicated on the Drawings but the installed dowel is under direct tension, the Contractor shall notify the Engineer to verify the required test value.

2. Contractor shall submit a plan and schedule indicating locations of dowels to be tested, load test values and proposed dowel testing procedure (including a diagram of the testing equipment proposed for use) prior to conducting any testing. The testing equipment shall have a minimum of three support points and shall be of sufficient size to locate the edge of supports no closer than two times the anchor embedment depth from the center of the anchor.

3. Where Contract Documents indicate adhesive dowel design is the Contractor's responsibility, the Contractor shall submit a plan and schedule indicating locations of dowels to be tested and load test values, sealed by a Professional Engineer currently registered in the State of Florida. The Contractor shall also submit documentation indicating the Contractor's testing procedures have been reviewed and the proposed procedures are acceptable.

4. Adhesive Dowel shall have no visible indications of displacement or damage during or after the proof test. Concrete cracking in the vicinity of the dowel after loading shall be considered a failure. Dowels exhibiting damage shall be removed and replaced. If more than 5 percent of tested dowels fail, then 100 percent of dowels shall be proof tested.

5. Proof testing of adhesive dowels shall be performed by an independent testing laboratory hired directly by the Contractor. The Contractor shall be responsible for costs of all testing, including additional testing required due to previously failed tests.

3.05 SPLICING

A. Reinforcing bar splices shall only be used at locations shown on the Drawings. When it is necessary to splice reinforcing at points other than where shown, the splice shall be as acceptable to the Engineer.

B. The length of lap for reinforcing bars, unless otherwise shown on the Drawings shall be in accordance with ACI 318 for a class B splice.

C. Laps of welded wire fabric shall be in accordance with ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each 2 running feet. Wires shall be staggered and tied in such a manner that they cannot slip.

D. Mechanical splices shall be used only where shown on the drawings or when approved by the Engineer.

E. Couplers which are located at a joint face shall be a type which can be set either flush or recessed from the face as shown on the Drawings. The couplers shall be sealed during concrete placement to completely eliminate concrete or cement paste from entering. After the concrete is placed, couplers intended for future connections shall be plugged and sealed to prevent any contact with water or other corrosive materials. Threaded couplers shall be plugged with plastic plugs which have an O-ring seal.

3.06 INSPECTION

A. The Contractor shall advise the Engineer of his intentions to place concrete and shall allow him adequate time to inspect all reinforcing steel before concrete is placed.

B. The Contractor shall advise the Engineer of his intentions to place grout in masonry walls and shall allow him adequate time to inspect all reinforcing steel before grout is placed.

3.07 CUTTING OF EMBEDDED REBAR

A. The Contractor shall not cut embedded rebar cast into structural concrete without prior approval.

- END OF SECTION -

SECTION 03250

CONCRETE ACCESSORIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor and equipment required to provide all concrete accessories including waterstops, expansion joint material, joint sealants, expansion joint seals, contraction joint inserts, and epoxy bonding agent.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03100 - Concrete Formwork

B. Section 03290 - Joints in Concrete

C. Section 03300 - Cast-in-Place Concrete

D. Section 07900 - Joint Fillers, Sealants, and Caulking

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1.	ASTM C881	Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
2.	ASTM D412	Standard Tests for Rubber Properties in Tension
3.	ASTM D 624	Standard Test method for Rubber Property - Tear Resistance
4.	ASTM D 638	Standard Test Method for Tensile Properties of Plastics
5.	ASTM D1751	Standard Specifications for Preformed Expansion Joint fillers for Concrete Paving and Structural Construction (nonextruding and resilient bituminous types)
6.	ASTM D 1752	Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
7.	ASTM D 1171	Standard Test Method for Ozone Resistance at 500 pphm

8. ASTM D 471 Standard Test Method for Rubber Properties

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01300, Submittals.

1. Manufacturer's literature on all products specified herein including material certifications.

2. Proposed system for supporting PVC waterstops in position during concrete placement

3. Samples of products if requested by the Engineer.

PART 2 -- PRODUCTS

2.01 POLYVINYL CHLORIDE (PVC) WATERSTOPS

A. PVC waterstops for construction joints shall be flat ribbed type, 6 inches wide with a minimum thickness at any point of 3/8 inches.

B. Waterstops for expansion joints shall be ribbed with a center bulb. They shall be 9 inches wide with a minimum thickness at any point of 3/8 inch unless shown or specified otherwise. The center bulb shall have a minimum outside diameter of 1 inch and a minimum inside diameter of 1/2 inch.

C. The waterstops shall be manufactured from virgin polyvinyl chloride plastic compound and shall not contain any scrap or reclaimed material or pigment whatsoever. The properties of the polyvinyl chloride compound used, as well as the physical properties of the waterstops, shall exceed the requirements of the U.S. Army Corps of Engineers' Specification CRD-C572. The waterstop material shall have an off-white, milky color.

D. The required minimum physical characteristics for this material are:

1. Tensile strength - 1,750 psi (ASTM D-638).

2. Ultimate elongation - not less than 280% (ASTM D-638).

E. No reclaimed PVC shall be used for the manufacturing of the waterstops. The Contractor shall furnish certification that the proposed waterstops meet the above requirements.

F. PVC waterstops shall be as manufactured by BoMetals, Inc., DuraJoint Concrete Accessories, or Sika Greenstreak.

G. All waterstop intersections, both vertical and horizontal, shall be made from factory fabricated corners and transitions. Only straight butt joint splices shall be made in field.

2.02 RETROFIT WATERSTOPS

A. Retrofit waterstops shall be used where specifically shown on Drawings for sealing joints between existing concrete construction and new construction.

B. Retrofit waterstops shall be PVC waterstops fabricated from material as described in Section 2.01 of this Specification.

C. Retrofit waterstop shall be attached to existing concrete surface as shown on Drawings.

D. Use of split waterstop in lieu of specially fabricated retrofit waterstop will not be acceptable.

E. Retrofit Waterstop manufacturer must provide a complete system including all Waterstop, stainless steel anchoring hardware, and epoxy for installation.

F. For construction joints, retrofit waterstop shall be style number 609 by Sika Greenstreak, RF-638 by BoMetals, Inc., Type 18 kit by DuraJoint Concrete Accessories, or approved equal. For expansion joints, retrofit waterstop shall be style number 667 by Sika Greenstreak, RF-912 by BoMetals, Inc., Type 18-9 kit by DuraJoint Concrete Accessories, or approved equal.

2.03 CHEMICAL RESISTANT WATERSTOPS

A. Where specifically noted on Contract Drawings, chemical resistant waterstops shall be used instead of PVC waterstops.

B. Chemical resistant waterstops for construction joints shall be ribbed with a center bulb. They shall be 6 inches wide with a minimum thickness at any point of 3/16 inches.

C. Chemical resistant waterstops for expansion joints shall be ribbed tear web. They shall be 9 inches wide with a tear web designed to accommodate 1 inch of free movement minimum.

D. Chemical resistant retrofit waterstop shall be a minimum of 2½” wide along the ribbed side and a minimum 5” wide along the side attached to the existing concrete surface. Retrofit waterstop shall include a centerbulb and shall have a minimum thickness of 3/16”. Retrofit waterstop manufacturer shall provide a complete system including waterstop, stainless steel anchoring hardware and epoxy for installation.

E. Chemical resistant waterstops shall be manufactured from a fully crosslinked thermoplastic vulcanizate rubber.

F. Waterstops shall be TPER by BoMetals, Inc., Earth Shield TPV/TPE-R by JP Specialties, Inc., Westec TPER by Westec Barrier Technologies, or TPE-R by DuraJoint Concrete Accessories.

2.04 HYPALON RUBBER WATERSTOPS

A. Hypalon rubber waterstops shall be Sikadur Combiflex by Sika Corporation or approved equal. Minimum width of waterstop material shall be twelve (12) inches unless shown otherwise on Contract Drawings.

2.05 EXPANDING RUBBER WATERSTOP

A. Expanding rubber shall be designed to expand under hydrostatic conditions. Waterstops shall be Adeka Ultra Seal MC-2010MN by Adeka Ultra Seal/OCM, Inc., or Hydrotite CJ-1020-2K by Sika Greenstreak, for concrete thickness greater than nine inches. For thicknesses less than nine inches, Adeka Ultra Seal KBA-1510FF or Hydrotite CJ-1020-2K shall be used.

B. Waterstop shall be a chemically modified natural rubber product with a hydrophilic agent.

C. Waterstop has a stainless steel mesh or coextrusion of non-hydrophilic rubber to direct expansion in the thickness direction and restrict the expansion in the longitudinal direction.

2.06 WATERSTOP ADHESIVE

A. Adhesive between waterstops and existing concrete shall be 20+F Contact Cement by Miracle Adhesives Corporation, Neoprene Adhesive 77-198 by JGF Adhesives, Sikadur 31 Hi-Mod Gel by Sika Corporation, DP-605 NS Urethane Adhesive by 3M Adhesive Systems.

B. Hydrophilic, non-bentonite water swelling elastic sealant shall be used to bond expanding rubber waterstops to rough surfaces. Hydrophilic elastic sealant shall be P-201 by Adeka Ultra Seal/OCM, Inc., Leakmaster LV-1 by Sika Greenstreak, or approved equal.

2.07 JOINT SEALANTS

A. Joint sealants shall comply with Section 07900, Joint Fillers, Sealants, and Caulking.

2.08 EXPANSION JOINT MATERIAL

A. Preformed expansion joint material shall be non-extruding, and shall be of the following types:

1. Type I - Sponge rubber, conforming to ASTM D1752, Type I.

2. Type II - Cork, conforming to ASTM D1752, Type II.

3. Type III - Self-expanding cork, conforming to ASTM D1752, Type III.

4. Type IV - Bituminous fiber, conforming to ASTM Designation D1751.

2.09 EXPANSION JOINT SEAL

A. Expansion Joint Seal System shall consist of a preformed neoprene profile, installed using the same dimensions as the joint gap, bonded with a two-component epoxy adhesive and pressurized during the adhesive cure time.

B. The expansion joint system shall be Hydrozo/Jeene Structural Sealing joint system by Hydrozo/Jeene, Inc.

2.10 CONTRACTION JOINT INSERTS

A. Contraction joint inserts shall be Zip-Cap by Greenstreak Plastic Products, Zip-Joint by BoMetals, Inc. control joint formers.

2.11 EPOXY BONDING AGENT

A. Epoxy bonding agent shall conform to ASTM C881 and shall be Sikadur 32 Hi-Mod, Sika Corporation, Lyndhurst, N.J.; Euco #452 Epoxy System, Euclid Chemical Company, Cleveland, OH, MasterInject 1500 by BASF Master Builder Solutions (BASF).

2.12 EPOXY RESIN BINDER

A. Epoxy resin binder shall conform to the requirements of ASTM C-881, Type III, Grade 3, Class B and C for epoxy resin binder and shall be Sikadur 23, Low-Mod-Gel, manufactured by the Sika Corporation, Lyndhurst, N.J., Flexocrete Gel manufactured by DuraJoint Concrete Accessories or Euco #352 Gel, Euclid Chemical Company, MasterEmaco ADH 327 or 327 RS by BASF Master Builder Solutions.

PART 3 -- EXECUTION

3.01 PVC AND CHEMICAL RESISTANT WATERSTOPS

A. PVC and chemical resistant waterstops shall be provided in all construction and expansion joints in water bearing structures and at other such locations as required by the Drawings.

B. Waterstops shall be carefully positioned so that they are embedded to an equal depth in concrete on both sides of the joint. They shall be kept free from oil, grease, mortar or other foreign matter. To ensure proper placement, all waterstops shall be secured in correct position at 12" on center along the length of the waterstop on each side, prior to placing concrete. Such method of support shall be submitted to the Engineer for review and approval. Grommets or small pre-punched holes as close to the edges as possible will be acceptable for securing waterstops.

C. Splices in PVC waterstops and chemical resistant waterstops shall be made with a thermostatically controlled heating element. Only straight butt joint splices will be allowed in the field. Factory fabricated corners and transitions shall be used at all

intersections. Splices shall be made in strict accordance with the manufacturer's recommended instructions and procedures. At least three satisfactory sample splices shall be made on the site. The Engineer may require tests on these splices by an approved laboratory. The splices shall exhibit not less than 80 percent of the strength of the unspliced material.

D. All splices in waterstops will be subject to rigid review for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, discoloration, charring, and other defects which would reduce the potential resistance of the material to water pressure at any point. All defective joints shall be replaced with material which will pass said review and all faulty material shall be removed from the site and disposed of by the Contractor at no additional cost to the Owner.

E. Retrofit waterstops shall be installed as shown on Contract Drawings using approved waterstop adhesive and Type 316 stainless steel batten bars and expansion anchors.

F. Waterstop installation and splicing defects which are unacceptable include, but are not limited to the following:

1. Tensile strength not less than 80 percent of parent material.

2. Overlapped (not spliced) Waterstop.

3. Misalignment of Waterstop geometry at any point greater than 1/16 inch.

4. Visible porosity or charred or burnt material in weld area.

5. Visible signs of splice separation when splice (24 hours or greater) is bent by hand at sharp angle.

3.02 HYPALON RUBBER AND EXPANDING RUBBER WATERSTOPS

A. Waterstops shall be installed only where shown on the Drawings.

B. Waterstops shall be installed in strict accordance with manufacturer's recommendations.

3.03 WATERSTOP ADHESIVE

A. Adhesive shall be applied to both contact surfaces in strict accordance with manufacturer's recommendations.

B. Adhesive shall be used where waterstops are attached to existing concrete surfaces.

3.04 INSTALLATION OF EXPANSION JOINT MATERIAL AND SEALANTS

A. Type I, II, or III shall be used in all expansion joints in structures and concrete pavements unless specifically shown otherwise on the Drawings. Type IV shall be used in sidewalk and curbing and other locations specifically shown on the Drawings.

B. All expansion joints exposed in the finish work, exterior and interior, shall be sealed with the specified joint sealant. Expansion joint material and sealants shall be installed in accordance with manufacturer's recommended procedures and as shown on the Drawings.

C. Expansion joint material that will be exposed after removal of forms shall be cut and trimmed to ensure a neat appearance and shall completely fill the joint except for the space required for the sealant. The material shall be held securely in place and no concrete shall be allowed to enter the joint or the space for the sealant and destroy the proper functions of the joint.

D. A bond breaker shall be used between expansion joint material and sealant. The joint shall be thoroughly clean and free from dirt and debris before the primer and the sealant are applied. Where the finished joint will be visible, masking of the adjoining surfaces shall be carried out to avoid their discoloration. The sealant shall be neatly tooled into place and its finished surfaces shall present a clean and even appearance.

E. Type 1 joint sealant shall be used in all expansion and contraction joints in concrete, except where Type 7 or Type 8 is required as stated below, and wherever else specified or shown on the Drawings. It shall be furnished in pour grade or gun grade depending on installation requirements. Primers shall be used as required by the manufacturer. The sealant shall be furnished in colors as directed by the Engineer.

F. Type 8 joint sealant shall be used in all concrete pavements and floors subject to heavy traffic and wherever else specified or shown on the Drawings.

G. Type 7 joint sealant shall be used for all joints in chlorine contact tanks and wherever specified or shown on the Drawings.

3.05 EXPANSION JOINT SEAL

A. The expansion joint seal system shall be installed as shown on the Drawings in strict accordance with the manufacturer's recommendations.

3.06 CONTRACTION JOINT INSERTS

A. For contraction joints in slabs, inserts shall be floated in fresh concrete during finishing.

B. For contraction joints in walls, inserts shall be secured in place prior to casting wall.

C. Inserts shall be installed true to line at the locations of all contraction joints as shown on the Drawings.

D. Inserts shall extend into concrete sufficient depth as indicated on the Drawings or specified in Section 03290, Joints in Concrete.

E. Inserts shall not be removed from concrete until concrete has cured sufficiently to prevent chipping or spalling of joint edges due to inadequate concrete strength.

3.07 EPOXY BONDING AGENT

A. The Contractor shall use an epoxy bonding agent for bonding fresh concrete to existing concrete as shown on the Drawings.

B. Bonding surface shall be clean, sound and free of all dust, laitance, grease, form release agents, curing compounds, and any other foreign particles.

C. Application of bonding agent shall be in strict accordance with manufacturer's recommendations.

D. Fresh concrete shall not be placed against existing concrete if epoxy bonding agent has lost its tackiness.

3.08 EPOXY RESIN BINDER

A. Epoxy resin binder shall be used to seal all existing rebar cut and burned off during demolition operations. Exposed rebar shall be burned back 1/2-inch minimum into existing concrete and the resulting void filled with epoxy resin binder.

- END OF SECTION -

SECTION 03290

JOINTS IN CONCRETE

PART 1 -- GENERAL

1.01 THE REQUIREMENTS

A. Provide all materials, labor and equipment required for the construction of all joints in concrete specified herein and shown on the Drawings.

B. Types of joints in concrete shall be as follows:

1. Construction Joints - Joints between adjacent concrete placements continuously connected with reinforcement.

2. Expansion Joints - Joints in concrete which allow thermal expansion and contraction of concrete. Reinforcement terminates within concrete on each side of joint.

3. Contraction Joints - Joints formed in concrete to provide a weakened plane in concrete section to control formation of shrinkage cracks.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03100 - Concrete Formwork

B. Section 03250 - Concrete Accessories

C. Section 03300 - Cast-in-Place Concrete

D. Section 07900 - Joint Fillers, Sealants and Caulking

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. ACI 301 - Specifications for Structural Concrete for Buildings

2. ACI 318 - Building Code Requirements for Structural Concrete

3. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures

4. ACI 224.3 – Joints in Concrete Construction

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01300, Submittals.

1. Layout drawings showing location and type of all joints to be placed in each structure.

2. Details of proposed joints in each structure.

3. For sawcut contraction joints submit documentation indicating the following:

a. Proposed method of sawcutting indicating early entry or conventional sawing.

b. Description of how work is to be performed including equipment to be utilized, size of crew performing the work and curing methods.

c. Description of alternate method in case of time constraint issues or failure of equipment.

PART 2 -- MATERIALS

2.01 MATERIALS

A. All materials required for joint construction shall comply with Section 03250 - Concrete Accessories, and Section 07900 - Joint Fillers, Sealants and Caulking.

PART 3 -- EXECUTION

3.01 CONSTRUCTION JOINTS

A. Construction joints shall be as shown on the Drawings. Otherwise, Contractor shall submit description of the joint and its location to Engineer for approval.

B. Unless noted otherwise on the Drawings, construction joints shall be located near the middle of the spans of slabs, beams, and girders unless a beam intersects a girder at this point. In this case, the joints in the girders shall be offset a distance equal to twice the width of the beam. Joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and the top of footings or floor slabs unless noted otherwise on Drawings. Beams, girders, brackets, column capitals, haunches, and drop panels shall be placed at the same time as slabs. Joints shall be perpendicular to the main reinforcement.

C. Maximum distance between horizontal joints in slabs and vertical joints in walls shall be 45'-0". For exposed walls with fluid or earth on the opposite side, the spacing between vertical and horizontal joints shall be a maximum of 25’-0”.

D. All corners shall be part of a continuous placement, and should a construction joint be required, the joint shall not be located closer than five feet from a corner.

E. All reinforcing steel and welded wire fabric shall be continued across construction joints. Keys and inclined dowels shall be provided as shown on the Drawings or as directed by the Engineer. Longitudinal keys shall be provided in all joints in walls and between walls and slabs or footings, except as specifically noted otherwise on the Drawings. Size of keys shall be as shown on the Drawings.

F. All joints in water bearing structures shall have a waterstop. All joints below grade in walls or slabs which enclose an accessible area shall have a waterstop.

3.02 EXPANSION JOINTS

A. Size and location of expansion joints shall be as shown on the Drawings.

B. All expansion joints in water-bearing structures shall have a center-bulb type waterstop. All expansion joints below grade in walls or slabs which enclose an accessible area shall have a center-bulb type waterstop. Waterstop shall be as shown on Drawings and specified in Section 03250, Concrete Accessories.

3.03 CONTRACTION JOINTS

A. Location of contraction joints shall be as shown on the Drawings.

B. Contraction joints shall be formed either by sawcutting or with contraction joint inserts as specified in Section 03250, Concrete Accessories. Sawcutting of joints will not be permitted unless specifically approved by the Engineer.

C. If approved by the Engineer, sawcutting of contraction joints in lieu of forming shall conform to the following requirements:

1. Joints shall be sawed as soon as the concrete can support foot traffic without leaving any impression, normally the same day as concrete is placed and in no case longer than 24 hours after concrete is placed.

2. Curing shall be performed using wet curing methods as indicated in Section 03370 – Concrete Curing. Curing mats, fabrics or sheeting materials shall remain in place to the extent possible while cutting of joint is being performed. Curing materials shall only be removed as required and shall be immediately reinstalled once cutting of the joint has been completed.

3. Depth of joint shall be as shown on the drawings or noted in these specifications. At locations where the joint cannot be installed to full depth due to curbs or other stopping points hand tools shall be used to complete joints.

4. Saw cut joints shall meet the requirements of ACI 224.3, Section 2.8, Jointing Practice.

D. Unless noted otherwise on Drawings, depth of contraction joints shall be 1½ inches in reinforced concrete and 1/3 of concrete thickness in unreinforced concrete.

3.04 JOINT PREPARATION

A. No concrete shall be allowed to enter the joint or the space for the sealant and destroy the proper functions of the joint.

B. The surface of the concrete at all joints shall be thoroughly cleaned and all laitance removed by wire brushing, air or light sand blasting.

C. The joint shall be thoroughly clean and free from dirt and debris before the primer and the sealant are applied. Where the finished joint will be visible, masking of the adjoining surfaces shall be carried out to avoid their discoloration. The sealant shall be neatly tooled into place and its finished surface shall present a clean and even appearance.

D. All joints shall be sealed as shown on the Drawings and specified in Section 03250, Concrete Accessories.

- END OF SECTION -

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Provide all labor, equipment, materials and services necessary for the manufacture, transportation and placement of all plain and reinforced concrete work, as shown on the Drawings or as ordered by the Engineer.

B. The requirements in this section shall apply to the following types of concrete:

1. Class A1 Concrete: Normal weight structural concrete to be used in all structures qualifying as environmental concrete structures that are designed in accordance with ACI 350 including pump stations, tanks, basins, process structures, and any structures containing fluid or process chemicals or other materials used in treatment process.

2. Class A2 Concrete: Normal weight structural concrete in all structures other than structures qualifying as environmental concrete structures as described above, and for all sidewalks and pavement.

3. Class B Concrete: Normal weight structural concrete used for duct bank encasements, catch basins, fence and guard post embedment, concrete fill, and other areas where specifically noted on Contract Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03100 - Concrete Formwork

B. Section 03200 - Reinforcing Steel

C. Section 03250 - Concrete Accessories

D. Section 03290 - Joints in Concrete

E. Section 03350 - Concrete Finishes

F. Section 03370 - Concrete Curing

G. Section 03600 - Grout

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the Specifications, all work herein shall conform to or exceed the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Building Code 6th Edition (2017)

2. ACI 214 Guide to Evaluation of Strength Test Results of Concrete

3. ACI 301 Specifications for Structural Concrete

4. ACI 304 Guide for Measuring, Mixing, Transporting, and Placing Concrete

5. ACI 305 Guide to Hot Weather Concreting

6. ACI 306 Guide to Cold Weather Concreting

7. ACI 309 Guide for Consolidation of Concrete

8. ACI 318 Building Code Requirements for Structural Concrete and Comentary

9. ACI 350 Code Requirements for Environmental Engineering Concrete Structures

10. ASTM C 31 Standard Practice for Making and Curing Concrete Test Specimens in the Field

11. ASTM C 33 Standard Specification for Concrete Aggregates

12. ASTM C 39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

13. ASTM C42 Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

14. ASTM C 88 Standard Test Method for Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate

15. ASTM C 94 Standard Specification for Ready-Mixed Concrete

16. ASTM C 114 Standard Test Method for Chemical Analysis of Hydraulic Cement

17. ASTM C 136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

18. ASTM C 138 Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete

19. ASTM C 143 Standard Test Method for Slump of Hydraulic Cement Concrete

20. ASTM C 150 Standard Specification for Portland Cement

21. ASTM C 172 Standard Practice for Sampling Freshly Mixed Concrete

22. ASTM C 192 Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory

23. ASTM C 231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

24. ASTM C 260 Standard Specification for Air-Entraining Admixtures for Concrete

25. ASTM C 295 Standard Guide for Petrographic Examination of Aggregates for Concrete

26. ASTM C 457 Standard Test Method for Microscopical Determination of the Air-Void System in Hardened Concrete

27. ASTM C 494 Standard Specification for Chemical Admixtures for Concrete

28. ASTM C 595 Standard Specification for Blended Hydraulic Cements

29. ASTM C 618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

30. ASTM C 989 Standard Specification for Slag Cement for Use in Concrete and Mortars

31. ASTM C 1077 Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation

32. ASTM C 1260 Test Method for Potential Alkali Reactivity of Aggregates (Mortar Bar Method)

33. ASTM C 1567 Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)

34. ASTM C 1602 Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

35. ASTM C 1778 Reducing the Risk of Deleterious Alkali – Aggregate Reaction in Concrete

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01300, Submittals.

1. Sources of all materials and certifications of compliance with specifications for all materials.

2. Certified current (less than 1 year old) chemical analysis of the Portland Cement or Blended Cement to be used.

3. Certified current (less than 1 year old) chemical analysis of fly ash or slag cement to be used.

4. Aggregate test results showing compliance with required standards, i.e., sieve analysis, potential reactivity, aggregate soundness tests, petrographic analysis, mortar bar expansion testing, etc.

5. Manufacturer's data on all admixtures stating compliance with required standards.

6. Concrete mix design for each class of concrete specified herein.

7. Field experience records and/or trial mix data for the proposed concrete mixes for each class of concrete specified herein.

1.05 QUALITY ASSURANCE

A. Tests on materials used in the production of concrete shall be required as specified in PART 2 -- PRODUCTS. These tests shall be performed by an independent testing laboratory approved by the Engineer at no additional cost to the County.

B. Trial concrete mixes shall be tested when required in accordance with Article 3.01 at no additional cost to the County.

C. Field quality control tests, as specified in Article 3.10, unless otherwise stated, will be performed by a materials testing consultant employed by the County. However, the Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the Specifications. Any individual who samples and tests concrete to determine if the concrete is being produced in accordance with this Specification shall be certified as a Concrete Field Testing Technician, Grade I, in accordance with ACI CP-2. Testing laboratory shall conform to requirements of ASTM C-1077.

1.06 CONCRETE COORDINATION CONFERENCE

A. Unless waived by the Engineer, prior to any concrete submittals and at least 35 days

prior to the start of the concrete construction schedule, the Contractor shall conduct a meeting at the site. The purpose of the meeting is to review the proposed concrete mix designs, to discuss the proposed approaches and procedures for mixing, transporting, placing, testing, finishing, and curing of all aspects of concrete work to ensure the concrete construction is performed in accordance with the Specifications, and to clarify roles of the parties involved. The Contractor shall send a concrete coordination conference agenda to all attendees 20 days prior to a mutually agreed upon date for the conference.

B. As a minimum the agenda shall include:

1. Concrete Materials and Mix Designs

2. Inspection Responsibilities

3. Concrete Sampling and Testing Specification Requirements

4. Cylinder Storage and Transportation

5. Acceptance/Rejection Responsibility and Authority for Fresh Concrete

6. Concrete finishing

7. Concrete Curing

8. Test Report Distribution

9. Miscellaneous Items

C. The Contractor shall require responsible representatives of every party who is concerned with the concrete work to attend the conference, including but not limited to the following:

1. Contractor’s superintendent

2. Engineer

3. County’s representative (if he chooses to attend)

4. Laboratory retained for trial batching and construction quality control testing for the concrete.

5. Any subcontractors involved in placing, finishing, and curing of concrete

6. Concrete supplier

7. Concrete pumping subcontractor (if pumping is being proposed)

D. Minutes of the meeting shall be recorded, typed, and printed by the Contractor and distributed to all attendees and any other concerned parties within five days of the meeting.

PART 2 -- PRODUCTS

2.01 HYDRAULIC CEMENT

A. Portland Cement

1. Portland Cement shall be Type II conforming to ASTM C 150. Type I cement may be used provided either fly ash or slag cement is also included in the mix in accordance with Articles 2.02 or 2.03 respectively.

2. When potentially reactive aggregates as defined in Article 2.05 are to be used in concrete mix, cement shall meet the following requirements:

   a. For concrete mixed with only Portland Cement, the total alkalies in the cement (calculated as the percentage of NA_2O plus 0.658 times the percentage of K_2O) shall not exceed 0.40%.

   b. For concrete mixed with Portland Cement and an appropriate amount of fly ash (Article 2.02) or slag cement (Article 2.03) the total alkalies in the Portland Cement (calculated as the percentage of NA_2O plus 0.658 times the percentage of K_2O) shall not exceed 0.85%.

3. When non-reactive aggregates as defined in Article 2.05 are used in concrete mix, total alkalies in the cement shall not exceed 1.0%.

4. The proposed Portland Cement shall not contain more than 8% tricalcium aluminate and more than 12% tetracalcium aluminoferrite.

B. Blended Cement

1. Blended cements shall be Type IP (Portland Fly Ash Cement) or Type IS (Portland Slag Cement) conforming to ASTM C 595.

2. Type IP cement shall be an interground blend of Portland Cement and fly ash in which the fly ash constituent is between 15% and 25% of the weight of the total blend.

3. Type IS cement shall be an interground blend of Portland Cement and slag cement in which the slag constituent is between 35% and 50% of the weight of the total blend.

4. Fly ash and slag cement used in the production of blended cements shall meet the requirements of Articles 2.02 and 2.03, respectively.

5. When reactive aggregates as defined in Article 2.05 are used in concrete mix, the total alkalies in the Portland Cement (calculated as the percentage of Na_2O plus 0.658 times the percentage of K_2O) shall not exceed 0.85%. The percentage of fly ash or slag cement shall be set to meet provisions of Article 2.05.G.3.

C. Different types of cement shall not be mixed nor shall they be used alternately except when authorized in writing by the Engineer. Different brands of cement or the same brand from different mills may be used alternately. A resubmittal will be required if different cements are proposed during the Project.

D. Cement shall be stored in a suitable weather-tight building so as to prevent deterioration or contamination. Cement which has become caked, partially hydrated, or otherwise damaged will be rejected.

2.02 FLY ASH

A. Fly ash shall meet the requirements of ASTM C 618 for Class F, except that the loss on ignition shall not exceed 4%. Fly ash shall also meet the optional physical requirements for uniformity as shown in Table 3 of ASTM C 618.

B. For fly ash to be used in the production of type IP cement, the Pozzolan Activity Index shall be greater than 75% as specified in Table 3 of ASTM C 595.

C. Where reactive aggregates as defined in Article 2.05 are used in concrete mix, the fly ash constituent shall be 20% of the total weight of the combined Portland Cement and fly ash. The percentage of fly ash shall be set to meet the mean mortar bar expansion requirements in provisions of Article 2.05.G.2.

D. For Type A1 concrete as required for use in environmental concrete structures, i.e. process structures or fluid containing structures, inclusion of fly ash or slag cement in the concrete mix, is mandatory.

E. Additional fly ash shall not be included in concrete mixed with Type IS or IP cement.

2.03 SLAG CEMENT

A. Slag cement shall meet the requirements of ASTM C 989 including tests for effectiveness of slag in preventing excessive expansion due to alkali-aggregate reactivity as described in Appendix X-3 of ASTM C 989.

B. Where reactive aggregates as defined in Article 2.05 are used in concrete mix, the slag cement constituent shall be between 35% and 40% of the total weight of the combined Portland Cement and slag. The percentage of slag cement shall be set to meet the mean mortar bar expansion requirements in provisions of Article 2.05.G.2.

C. For Type A1 concrete as required for use in environmental concrete structures, i.e. process structures or fluid containing structures, inclusion of fly ash or slag cement in the concrete mix, is mandatory.

D. Additional slag cement shall not be included in concrete mixed with type IS or IP cement.

2.04 WATER

A. Water used for mixing concrete shall be clear, potable and free from deleterious substances such as objectionable quantities of silty organic matter, alkali, salts and other impurities.

B. Water shall not contain more than 100 PPM chloride.

C. Water shall not contain more than 500 PPM dissolved solids.

D. Water shall have a pH in the range of 4.5 to 8.5.

E. Water shall meet requirements of ASTM C 1602.

2.05 AGGREGATES

A. All aggregates used in normal weight concrete shall conform to ASTM C 33.

B. Fine Aggregate (Sand) in the various concrete mixes shall consist of natural or manufactured siliceous sand, clean and free from deleterious substances, and graded within the limits of ASTM C 33.

C. Coarse aggregates shall consist of hard, clean, durable gravel, crushed gravel or crushed rock. Coarse aggregate shall be size #57 or #67 as graded within the limits given in ASTM C 33 unless otherwise specified.

D. For Class A4 concrete, coarse aggregate shall be Size #8 in accordance with ASTM C33.

E. Aggregates shall be tested for gradation by sieve analysis tests in conformance with ASTM C 136.

F. Aggregates shall be tested for soundness in accordance with ASTM C 88. The loss resulting after five cycles shall not exceed 10 percent for fine or coarse aggregate when using either magnesium sulfate or sodium sulfate.

G. All aggregates shall be evaluated in accordance with ASTM C 1778 to determine potential reactivity. All aggregates shall be considered reactive unless they meet the requirements below for non-reactive aggregates. Aggregates with a lithology essentially similar to sources in the same region found to be reactive in service shall be considered reactive regardless of the results of the tests above.

1. Non-reactive aggregates shall meet the following requirements:

A petrographic analysis in accordance with ASTM C295 shall be performed to identify the constituents of the fine and coarse aggregate. Non-reactive aggregates shall meet the following limitations:

(a) Optically strained, microfractured, or microcrystalline quartz, 5.0%, maximum.

(b) Chert or chalcedony, 3.0%, maximum.

(c) Tridymite or cristobalite, 1.0%, maximum.

(d) Opal, 0.5%, maximum.

e) Natural volcanic glass in volcanic rocks, 3.0%, maximum.

3. Concrete mix with reactive aggregate shall meet the following requirements:

If aggregates are deemed potentially reactive as per ASTM C-1778 and fly ash or slag cement is included in proposed concrete mix design, proposed concrete mix including proposed aggregates shall be evaluated by ASTM C-1567. Mean mortar bar expansions at 16 days shall be less than 0.08%. Tests shall be made using exact proportion of all materials proposed for use on the job in design mix submitted.

If aggregates are deemed potentially reactive as per ASTM C-1778 and a straight cement mix without fly ash or slag cement is proposed for concrete mix design, aggregates shall be evaluated by ASTM C-1260. Mean mortar bar expansions at 16 days shall be less than 0.08%.

H. Contractor shall submit a new trial mix to the Engineer for approval whenever a different aggregate or gradation is proposed.

2.06 STRUCTURAL MACRO FIBERS

A. Structural macro fibers shall meet requirements of ASTM C 1116 with a minimum length of 2 inches, an aspect ratio between 50 and 90, and a minimum toughness rating R10, 50=60 (approximate) in accordance with ASTM C 1609. Fibers shall be used only where specifically required on Contract Drawings or where specifically approved by Engineer.

B. Acceptable structural macro fibers are Tuf Strand SF by the Euclid Chemical Company, Strux 90/40 by W.R. Grace, or equal.

2.07 ADMIXTURES

A. Air entraining agent shall be added to all concrete unless noted otherwise. The agent shall consist of a neutralized vinsol resin solution or a purified hydrocarbon with a cement catalyst which will provide entrained air in the concrete in accordance with ASTM C 260. The admixture proposed shall be selected in advance so that adequate

samples may be obtained and the required tests made. Air content of concrete, when placed, shall be within the ranges given in the concrete mix design.

B. The following admixtures are required or used for water reduction, slump increase, and/or adjustment of initial set. Admixtures permitted shall confirm to the requirements of ASTM C 494. Admixtures shall be non-toxic after 30 days and shall be compatible with and made by the same manufacturer as the air-entraining admixtures.

1. Water reducing admixture shall conform to ASTM C 494, Type A and shall contain no more than 0.05% chloride ions. Acceptable products are “Eucon Series” by the Euclid Chemical Company, “Master Pozzolith Series” by BASF, and “Plastocrete Series” by Sika Corporation.

2. High range water reducer shall be sulfonated polymer conforming to ASTM C 494, Type F or G. The high range water reducer shall be added to the concrete at either the batch plant or at the job site and may be used in conjunction with a water reducing admixture. The high range water reducer shall be accurately measured and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested prior to each day’s operation of the job site system. Concrete shall be mixed at mixing speed for a minimum of 100 mixer revolutions after the addition of the high range water reducer. Acceptable products are “Eucon 37” or Plastol 5000 by the Euclid Chemical Company, “Master Rheobuild 1000 or Master Glenium Series” by BASF, and “Daracem 100 or Advaflow Series” by W.R. Grace.

3. A non-chloride, non-corrosive accelerating admixture may be used where specifically approved by the Engineer. The admixture shall conform to ASTM C 494, Type C or E, and shall not contain more chloride ions than are present in municipal drinking water. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year’s duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures. Acceptable products are “Accelguard 80/90 or NCA” by the Euclid Chemical Company and “Daraset” by W.R. Grace.

4. A water reducing retarding admixture may be used where specifically approved by the Engineer. The admixture shall conform to ASTM C494, Type D and shall not contain more than 0.05% chloride ions. Acceptable products are “Eucon NR or Eucon Retarder 100” by the Euclid Chemical Company, “Pozzolith Retarder” by BASF, and “Plastiment” by Sika Corporation.

C. Admixtures containing calcium chloride, thiocyanate or more than 0.05 percent chloride ions are <u>not</u> permitted. The addition of admixtures to prevent freezing is not permitted.

D. The Contractor shall submit manufacturer's data including the chloride ion content of each admixture and certification from the admixture manufacturer that all admixtures utilized in the design mix are compatible with one another and properly proportioned prior to mix design review.

2.08 CONCRETE MIX DESIGN

A. The proportions of cement, aggregates, admixtures and water used in the concrete mixes shall be based on the results of field experience or preferably laboratory trial mixes in conformance with Section 5.3. "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318 and ACI 350. When trial mixes are used they shall also conform to Article 3.01 of this Section of the Specifications. If field experience records are used, concrete strength results shall be from concrete mixed with all of the ingredients proposed for use on job used in similar proportions to mix proposed for use on job. Contractor shall submit verification confirming this stipulation has been followed. Field experience records and/or trial mix data used as the basis for the proposed concrete mix design shall be submitted to the Engineer along with the proposed mix.

B. Structural concrete shall conform to the following requirements. Cementitious materials refer to the total combined weight of all cement, fly ash, and slag cement contained in the mix.

1.	Compressive Strength (28-Day)		
	a. Concrete Class A1	4,500 psi (minimum)	
	b. Concrete Class A2	4,000 psi (minimum)	
	c. Concrete Class B	3,000 psi (minimum)	
2.	Water/cementitious materials ratio, by weight		
		Maximum	Minimum
	a. Concrete Class A1	0.42	0.39
	b. Concrete Class A2	0.45	0.39
	c. Concrete Class B	0.50	0.39
3.	Slump range	4" nominal unless high range water reducing admixture is used. 8” max if high range water reducing admixture is used.	
4.	Air Content		
	a. Class A1, A2	6% ±1.5%	
	b. Class B	3% Max (non-air-entrained)	

PART 3 -- EXECUTION

3.01 TRIAL MIXES

A. When trial mixes are used to confirm the quality of a proposed concrete mix in accordance with Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318 and ACI 350, an independent qualified testing laboratory designated and retained by the Contractor shall test a trial batch of each of the preliminary concrete mixes submitted by the Contractor. The trial batches shall be prepared using the aggregates, cement and admixtures proposed for the project. The trial batch materials shall be of a quantity such that the testing laboratory can obtain enough samples to satisfy requirements stated below. Tests on individual materials stated in PART 2 -- PRODUCTS should already be performed before any trial mix is done. The cost of laboratory trial batch tests for each specified concrete mix will be

borne by the Contractor and the Contractor shall furnish and deliver the materials to the testing laboratory at no cost to the County.

B. The independent testing laboratory shall prepare a minimum of fifteen (15) standard test cylinders in accordance with ASTM C 31 in addition to conducting slump (ASTM C 143), air content (C 231) and unit weight (C 138) tests. Compressive strength test on the cylinders shall subsequently be performed by the same laboratory in accordance with ASTM C 39 as follows: Test 3 cylinders at age 7 days; test 3 cylinders at age 21 days; test 3 cylinders at age 28 days and test 3 cylinders at 56 days. The cylinders shall be carefully identified as "Trial Mix, Contract No. _____, Product _____." If the average 28-day compressive strength of the trial mix is less than that specified, or if any single cylinder falls below the required strength by more than 500 psi, the mix shall be corrected, another trial batch prepared, test cylinders taken, and new tests performed as before. Any such additional trial batch testing required shall be performed at no additional cost to the County. Adjustments to the mix shall be considered refinements to the mix design and shall not be the basis for extra compensation to the Contractor.

3.02 PRODUCTION OF CONCRETE

A. All concrete shall be machine mixed. Hand mixing of concrete will not be permitted. The Contractor may supply concrete from a ready mix plant or from a site mixed plant. In selecting the source for concrete production the Contractor shall carefully consider its capability for providing quality concrete at a rate commensurate with the requirements of the placements so that well bonded, homogenous concrete, free of cold joints, is assured.

B. Ready-Mixed Concrete

1. At the Contractor's option, ready-mixed concrete may be used meeting the requirements for materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C 94.

2. Truck mixers shall be equipped with electrically-actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.

3. Each batch of concrete shall be mixed in a truck mixer for not less than 100 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.

4. Truck mixers and their operation shall be such that the concrete throughout the mixed batch, as discharged, is within acceptable limits of uniformity with respect to consistency, mix and grading. If slump tests taken at approximately the 1/4 and 3/4 points of the load during discharge give slumps differing by more than

one inch when the specified slump is 3 inches or less, or if they differ by more than 2 inches when the specified slump is more than 3 inches, the mixer shall not be used on the work unless the causing condition is corrected and satisfactory performance is verified by additional slump tests. All mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.

5. Ready-mixed concrete shall be delivered to the site for the work and discharge shall be completed before the drum has been revolved 300 revolutions and within the time requirements stated in Article 3.03 of this Section.

6. Each and every concrete delivery shall be accompanied by a delivery ticket containing at least the following information:

   a. Date and truck number
   b. Ticket number
   c. Mix designation of concrete
   d. Cubic yards of concrete
   e. Cement brand, type and weight in pounds
   f. Weight in pounds of fine aggregate (sand)
   g. Weight in pounds of coarse aggregate (stone)
   h. Air entraining agent, brand, and weight in pounds and ounces
   i. Other admixtures, brand, and weight in pounds and ounces
   j. Water, in gallons, stored in attached tank
   k. Water, in gallons, maximum that can be added without exceeding design water/cementitious materials ratio
   l. Water, in gallons, actually used (by truck driver)
   m. Time of loading
   n. Time of delivery to job (by truck driver)

7. Any truck delivering concrete to the job site, which is not accompanied by a delivery ticket showing the above information will be rejected and such truck shall immediately depart from the job site.

8. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by the Engineer.

C. Site Mixed Concrete

1. Scales for weighing concrete ingredients shall be accurate when in use within ±0.4 percent of their total capacities. Standard test weights shall be available to permit checking scale accuracy.

2. Operation of batching equipment shall be such that the concrete ingredients are consistently measured within the following tolerances:

a.	Cement, fly ash, or slag cement	± 1 percent
b.	Water	± 1 percent
c.	Aggregates	± 2 percent
d.	Admixtures	± 3 percent

3. Each batch shall be so charged into the mixer that some water will enter in advance of the cement and aggregates. Water shall continue for a period which may extend to the end of the first 25 percent of the specified mixing time. Controls shall be provided to prevent batched ingredients from entering the mixer before the previous batch has been completely discharged.

4. The concrete shall be mixed in a batch mixer capable of thoroughly combining the aggregates, cement, and water into a uniform mass within the specified mixing time, and of discharging the concrete without harmful segregation. The mixer shall bear a manufacturer's rating plate indicating the rate capacity and the recommended revolutions per minute and shall be operated in accordance therewith.

5. Mixers with a rate capacity of 1 cu.yd. or larger shall conform to the requirements of the Plant Mixer Manufacturers' Division of the Concrete Plant Manufacturers' Bureau.

6. Except as provided below, batches of 1 cu. yd. or less shall be mixed for not less than 1 minute. The mixing time shall be increased 15 seconds for each cubic yard or fraction thereof of additional capacity.

7. Shorter mixing time may be permitted provided performance tests made in accordance with of ASTM C 94 indicate that the time is sufficient to produce uniform concrete.

8. Controls shall be provided to insure that the batch cannot be discharged until the required mixing time has elapsed. At least three-quarters of the required mixing time shall take place after the last of the mixing water has been added.

9. The interior of the mixer shall be free of accumulations that will interfere with mixing action. Mixer blades shall be replaced when they have lost 10 percent of their original height.

10. Air-entraining admixtures and other chemical admixtures shall be charged into the mixer as solutions and shall be measured by means of an approved mechanical dispensing device. The liquid shall be considered a part of the mixing water. Admixtures that cannot be added in solution may be weighed or may be measured by volume if so recommended by the manufacturer.

11. If two or more admixtures are used in the concrete, they shall be added separately to avoid possible interaction that might interfere with the efficiency of either admixture or adversely affect the concrete.

12. Addition of retarding admixtures shall be completed within 1 minute after addition of water to the cement has been completed, or prior to the beginning of the last three-quarters of the required mixing, whichever occurs first. Retarding admixtures shall not be used unless approved by the Engineer.

13. Concrete shall be mixed only in quantities for immediate use and within the time and mixing requirements of ASTM C 94.

3.03 CONCRETE PLACEMENT

A. No concrete shall be placed prior to approval of the concrete mix design. Concrete placement shall conform to the recommendations of ACI 304.

B. Prior to concrete placement, all reinforcement shall be securely and properly fastened in its correct position. Formwork shall be clean, oiled and form ties at construction joints shall be retightened. All bucks, sleeves, castings, hangers, pipe, conduits, bolts, anchors, wire, and any other fixtures required to be embedded therein shall be in place. Forms for openings to be left in the concrete shall be in place and anchored by the Contractor. All loose debris in bottoms of forms or in keyways shall be removed and all debris, water, snow, ice and foreign matter shall be removed from the space to be occupied by the concrete. The Contractor shall notify the Engineer in advance of placement, allowing sufficient time for a concurrent inspection and for any corrective measures which are subsequently required.

C. On horizontal joints where concrete is to be placed on hardened concrete, flowing concrete containing a high range water reducing admixture or cement grout shall be placed with a slump not less than 8 inches for the initial placement at the base of the wall. Concrete or cement grout shall meet all strength and service requirements specified herein for applicable class of concrete. This concrete shall be worked well into the irregularities of the hard surface.

D. All concrete shall be placed during the daylight hours except with the consent of the Engineer. If special permission is obtained to carry on work during the night, adequate lighting must be provided.

E. When concrete arrives at the project with slump below that suitable for placing, as indicated by the Specifications, water may be added to bring the concrete within the specified slump range provided that the design water-cementitious materials ratio is not exceeded. The water shall be incorporated by additional mixing equal to at least half of the total mixing required. Water may be added only to full trucks. On-site tempering shall not relieve the Contractor from furnishing a concrete mix that meets all specified requirements.

F. Concrete shall be conveyed as rapidly as practicable to the point of deposit by methods which prevent the separation or loss of the ingredients. It shall be so deposited that

rehandling will be unnecessary. Discharge of the concrete to its point of deposit shall be completed within 90 minutes after the addition of the cement to the aggregates. In hot weather, or under conditions contributing to quick stiffening of the concrete, the time between the introduction of the cement to the aggregates and discharge shall not exceed the requirements stated in Article 3.09 of this Section.

G. Where concrete is conveyed to position by chutes, a practically continuous flow in the chute shall be maintained. The angle and discharge arrangement of the chute shall be such as to prevent segregation of the concrete ingredients. The delivery end of the chute shall be as close as possible to the point of deposit and in no case shall the free pour from the delivery end of the chute exceed five feet, unless approved otherwise.

H. Special care must be exercised to prevent splashing of forms or reinforcement with concrete, and any such splashes or accumulations of hardened or partially hardened concrete on the forms or reinforcement above the general level of the concrete already in place must be removed before the work proceeds. Concrete shall be placed in all forms in such way as to prevent any segregation.

I. Placing of concrete shall be so regulated that the pressure caused by the wet concrete shall not exceed that used in the design of the forms.

J. All concrete for walls shall be placed through openings in the form spaced at frequent intervals or through tremies (heavy duct canvas, rubber, etc.), equipped with suitable hopper heads. Tremies shall be of variable lengths so the free fall shall not exceed five (5) feet and a sufficient number shall be placed in the form to ensure the concrete is kept level at all times.

K. When placing concrete which is to be exposed, sufficient illumination shall be provided in the interior of the forms so the concrete, at places of deposit, is visible from deck and runways.

L. Concrete shall be placed so as to thoroughly embed all reinforcement, inserts, and fixtures.

M. When forms are removed, surfaces shall be even and dense, free from aggregate pockets or honeycomb. To achieve this, concrete shall be consolidated using mechanical vibration, supplemented by forking and spading by hand in the corners and angle of forms and along form surfaces while the concrete is plastic under the vibratory action. Consolidation shall conform to ACI 309.

N. Mechanical vibration shall be applied directly to the concrete, unless otherwise approved by the Engineer. The bottom of vibrators used on floor slabs must not be permitted to ride the form supporting the slab. Vibration shall be applied at the point of deposit and in the area of freshly placed concrete by a vertical penetration of the vibrator. Vibrators shall not be used to move concrete laterally within the forms.

O. The intensity of vibration shall be sufficient to cause settlement of the concrete into place and to produce monolithic joining with the preceding layer. It shall be of sufficient duration to accomplish thorough compaction and complete embedment of reinforcement

and fixtures with a vibrator transmitting not less than 7,500 impulses per minute. Since the duration of vibration per square foot of surface is dependent on the frequency (impulses per minute), size of vibrator, and slump of concrete, the length of time must therefore be determined in the field. Vibration, however, shall not be continued in any one location to the extent that pools of grout are formed.

P. Care shall be taken to prevent cold joints when placing concrete in any portion of the work. The concrete placing rate shall be such as to ensure that each layer is placed while the previous layer is soft or plastic, so that the two layers can be made monolithic by penetration of the vibrators. Maximum thickness of concrete layers shall be 18 inches. The surface of the concrete shall be level whenever a run of concrete is stopped.

Q. To prevent featheredges, construction joints located at the tops of horizontal lifts near sloping exposed concrete surfaces shall be inclined near the exposed surface, so the angle between such inclined surface and the exposed concrete surface will be not less than 50°.

R. In placing unformed concrete on slopes, the concrete shall be placed ahead of a non-vibrated slip-form screed extending approximately 2-1/2 feet back from its leading edge. The method of placement shall provide a uniform finished surface with the deviation from the straight line less than 1/8 inch in any concrete placement. Concrete ahead of the slip-form screed shall be consolidated by internal vibrators so as to ensure complete filling under the slip-form. Prior to placement of concrete on sloped walls or slabs, the Contractor shall submit a plan specifically detailing methods and sequence of placements, proposed concrete screed equipment, location of construction joints and waterstops, and/or any proposed deviations from the aforementioned to the Engineer for review and approval.

S. Concrete shall not be placed during rains sufficiently heavy or prolonged to wash mortar from coarse aggregate on the forward slopes of the placement. Once placement of concrete has commenced in a block, placement shall not be interrupted by diverting the placing equipment to other uses.

3.04 PLACING FLOOR SLABS ON GRADE

A. The subgrade for slabs on ground shall be well drained and of adequate and uniform loadbearing nature. The in-place density of the subgrade soils shall be at least the minimum required by the specifications. No foundation, slab, or pavement concrete shall be placed until the depth and character of the foundation soils have been inspected and approved by the materials testing consultant.

B. The subgrade shall be free of frost before concrete placing begins. If the temperature inside a building where concrete is to be placed is below freezing it shall be raised and maintained above 50° long enough to remove all frost from the subgrade.

C. The subgrade shall be moist at the time of concreting. If necessary, it shall be dampened with water in advance of concreting, but there shall be no free water standing on the subgrade nor any muddy or soft spots when the concrete is placed.

D. Thirty-pound felt paper shall be provided between edges of slab-on-grade and vertical and horizontal concrete surfaces, unless otherwise indicated on the Drawings.

E. Contraction joints shall be provided in slabs-on-grade at locations indicated on the Drawings. Contraction joints shall be installed as per Section 03290 - Joints in Concrete.

F. Floor slabs shall be screeded level or pitched to drain as indicated on the Drawings. Finishes shall conform with requirements of Section 03350 - Concrete Finishes. Interior floor slabs shall be placed with non-air-entrained concrete (Class A3) if a steel troweled or hardened finish is required.

3.06 PLACING CONCRETE UNDER PRESSURE

A. Where concrete is conveyed and placed by mechanically applied pressure, the equipment shall have the capacity for the operation. The operation of the pump shall be such that a continuous stream of concrete without air pockets is produced. To obtain the least line resistance, the layout of the pipeline system shall contain a minimum number of bends with no change in pipe size. If two sizes of pipe must be used, the smaller diameter should be used at the pump end and the larger at the discharge end. When pumping is completed, the concrete remaining in the pipelines, if it is to be used, shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients.

B. Priming of the concrete pumping equipment shall be with cement grout only. Use of specialty mix pump primers or pumping aids will not be allowed.

C. No aluminum parts shall be in contact with the concrete during the entire placing of concrete under pressure at any time.

D. Prior to placing concrete under pressure, the Contractor shall submit the concrete mix design together with test results from a materials testing consultant proving the proposed mix meets all requirements. In addition, an actual pumping test under field conditions is required prior to acceptance of the mix. This test requires a duplication of anticipated site conditions from beginning to end. The batching and truck mixing shall be the same as will be used; the same pump and operator shall be present and the pipe and pipe layouts will reflect the maximum height and distance contemplated. All submissions shall be subject to approval by the Engineer.

E. If the pumped concrete does not produce satisfactory end results, the Contractor shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.

F. The pumping equipment must have two cylinders and be designed to operate with one cylinder only in case the other one is not functioning. In lieu of this requirement, the Contractor may have a standby pump on the site during pumping.

G. The minimum diameter of the hose (conduits) shall be four inches.

H. Pumping equipment and hoses (conduits) that are not functioning properly shall be replaced.

I. Concrete samples for quality control in accordance with Article 3.10 will be taken at the placement (discharge) end of the line.

3.07 ORDER OF PLACING CONCRETE

A. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints shown on the Drawings and maximum lengths as indicated on Drawings. Where required on the Drawings and wherever else practical, the placing of such units shall be done in a strip pattern in accordance with ACI 302.1. A minimum of 72 hours shall pass prior to placing concrete directly adjacent to previously placed concrete.

3.08 CONCRETE WORK IN COLD WEATHER

A. Cold weather concreting procedures shall conform to the requirements of ACI 306.

B. The Engineer may prohibit the placing of concrete at any time when air temperature is 40°F. or lower. If concrete work is permitted, the concrete shall have a minimum temperature, as placed, of 55°F. for placements less than 12" thick, 50°F. for placements 12" to 36" thick, and 45°F. for placements greater than 36" thick. The temperature of the concrete as placed shall not exceed the aforementioned minimum values by more than 20°F, unless otherwise approved by the Engineer.

C. All aggregate and water shall be preheated. Precautions shall be taken to avoid the possibility of flash set when aggregate or water are heated to a temperature in excess of 100°F. in order to meet concrete temperature requirements. The addition of admixtures to the concrete to prevent freezing is not permitted. All reinforcement, forms, and concrete accessories with which the concrete is to come in contact shall be defrosted by an approved method. No concrete shall be placed on frozen ground.

3.09 CONCRETE WORK IN HOT WEATHER

A. Hot weather concreting procedures shall conform to the requirements of ACI 305.

B. When air temperatures exceed 85°F., or when extremely dry conditions exist even at lower temperatures, particularly if accompanied by high winds, the Contractor and his concrete supplier shall exercise special and precautionary measures in preparing, delivering, placing, finishing, curing and protecting the concrete mix. The Contractor shall consult with the Engineer regarding such measures prior to each day's placing operation and the Engineer reserves the right to modify the proposed measures consistent with the requirements of this Section of the Specifications. All necessary materials and equipment shall be on hand an in position prior to each placing operation.

C. Preparatory work at the job site shall include thorough wetting of all forms, reinforcing steel and, in the case of slab pours on ground or subgrade, spraying the ground surface

on the preceding evening and again just prior to placing. No standing puddles of water shall be permitted in those areas which are to receive the concrete.

D. The temperature of the concrete mix when placed shall not exceed 90°F.

E. Temperature of mixing water and aggregates shall be carefully controlled and monitored at the supplier's plant, with haul distance to the job site being taken into account. Stockpiled aggregates shall, if necessary, be shaded from the sun and sprinkled intermittently with water. If ice is used in the mixing water for cooling purposes, it must be entirely melted prior to addition of the water to the dry mix.

F. Delivery schedules shall be carefully planned in advance so that concrete is placed as soon as practical after it is properly mixed. For hot weather concrete work (air temperature greater than 85°F), discharge of the concrete to its point of deposit shall be completed within 60 minutes from the time the concrete is batched.

G. The Contractor shall arrange for an ample work force to be on hand to accomplish transporting, vibrating, finishing, and covering of the fresh concrete as rapidly as possible.

3.10 QUALITY CONTROL

A. Field Testing of Concrete

1. The Contractor shall coordinate with the Engineer's project representative the on-site scheduling of the materials testing consultant personnel as required for concrete testing.

2. Concrete for testing shall be supplied by the Contractor at no additional cost to the County, and the Contractor shall provide assistance to the materials testing consultant in obtaining samples. The Contractor shall dispose of and clean up all excess material.

B. Consistency

1. The consistency of the concrete will be checked by the materials testing consultant by standard slump cone tests. The Contractor shall make any necessary adjustments in the mix as the Engineer and/or the materials testing consultant may direct and shall upon written order suspend all placing operations in the event the consistency does not meet the intent of the specifications. No payment shall be made for any delays, material or labor costs due to such eventualities.

2. Slump tests shall be made in accordance with ASTM C 143. Slump tests will be performed as deemed necessary by the materials testing consultant and each time compressive strength samples are taken.

3. Concrete with a specified nominal slump shall be placed having a slump within 1” (higher or lower) of the specified slump. Concrete with a specified maximum slump shall be placed having a slump less than the specified slump.

C. Unit Weight

1. Samples of freshly mixed concrete shall be tested for unit weight by the materials testing consultant in accordance with ASTM C 138.

2. Unit weight tests will be performed as deemed necessary by the Engineer and each time compressive strength samples are taken.

D. Air Content

1. Samples of freshly mixed concrete will be tested for entrained air content by the materials testing consultant in accordance with ASTM C 231.

2. Air content tests will be performed as deemed necessary by the materials testing consultant and each time compressive strength samples are taken.

3. In the event test results are outside the limits specified, additional testing shall occur. Admixture quantity adjustments shall be made immediately upon discovery of incorrect air entrainment.

E. Compressive Strength

1. Samples of freshly mixed concrete will be taken by the materials testing consultant and tested for compressive strength in accordance with ASTM C 172, C 31 and C 39, except as modified herein.

2. In general, one sampling shall be taken for each placement in excess of five (5) cubic yards, with a minimum of one (1) sampling for each day of concrete placement operations, or for each one hundred (100) cubic yards of concrete, or for each 5,000 square feet of surface area for slabs or walls, whichever is greater.

3. Each sampling shall consist of at least five (5) 6x12 cylinders or (8) 4x8 cylinders. Each cylinder shall be identified by a tag, which shall be hooked or wired to the side of the container. The materials testing consultant will fill out the required information on the tag, and the Contractor shall satisfy himself that such information shown is correct.

4. The Contractor shall be required to furnish labor to the County for assisting in preparing test cylinders for testing. The Contractor shall provide approved curing boxes for storage of cylinders on site. The insulated curing box shall be of sufficient size and strength to contain all the specimens made in any four consecutive working days and to protect the specimens from falling over, being jarred or otherwise disturbed during the period of initial curing. The box shall be erected, furnished and maintained by the Contractor. Such box shall be

equipped to provide the moisture and to regulate the temperature necessary to maintain the proper curing conditions required by ASTM C 31. Such box shall be located in an area free from vibration such as pile driving and traffic of all kinds and such that all specimen are shielded from direct sunlight and/or radiant heating sources. No concrete requiring inspection shall be delivered to the site until such storage curing box has been provided. Specimens shall remain undisturbed in the curing box until ready for delivery to the testing laboratory but not less than sixteen hours.

5. The Contractor shall be responsible for maintaining the temperatures of the curing box during the initial curing of test specimens with the temperature preserved between 60°F and 80°F as measured by a maximum-minimum thermometer. The Contractor shall maintain a written record of curing box temperatures for each day curing box contains test specimens. Temperature shall be recorded a minimum of three times a day with one recording at the start of the work day and one recording at the end of the work day.

6. When transported, the cylinders shall not be thrown, dropped, allowed to roll, or be damaged in any way.

7. Compression tests shall be performed in accordance with ASTM C 39. For 6x12 cylinders, two test cylinders will be tested at seven days and two at 28 days. For 4x8 cylinders, three test cylinders will be tested at seven days, three at 28 days. The remaining cylinders will be held to verify test results, if needed.

F. Evaluation and Acceptance of Concrete

1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 214, ACI 318, and ACI 350.

2. The strength level of concrete will be considered satisfactory if all of the following conditions are satisfied.

   a. Every arithmetic average of any three consecutive strength tests equals or exceeds the minimum specified 28-day compressive strength for the mix (see Article 2.08).

   b. No individual compressive strength test results falls below the minimum specified strength by more than 500 psi.

3. In the event any of the conditions listed above are not met, the mix proportions shall be corrected for the next concrete placing operation.

4. In the event that condition 2B is not met, additional tests in accordance with Article 3.10, paragraph H shall be performed.

5. When a ratio between 7-day and 28-day strengths has been established by these tests, the 7-day strengths shall subsequently be taken as a preliminary

indication of the 28-day strengths. Should the 7-day test strength from any sampling be more than 10% below the established minimum strength, the Contractor shall:

a. Immediately provide additional periods of curing in the affected area from which the deficient test cylinders were taken.

b. Maintain or add temporary structural support as required.

c. Correct the mix for the next concrete placement operation, if required to remedy the situation.

6. All concrete which fails to meet the ACI requirements and these specifications is subject to removal and replacement at no additional cost to the County.

G. When non-compliant concrete is identified, test reports shall be sent immediately to the Engineer for review.

H. Additional Tests

1. When ordered by the Engineer, additional tests on in-place concrete shall be provided and paid for by the Contractor.

2. In the event the 28-day test cylinders fail to meet the minimum strength requirements as outlined in Article 3.10, paragraph F, the Contractor shall have concrete core specimens obtained and tested from the affected area immediately.

a. Three cores shall be taken for each sample in which the strength requirements were not met.

b. The drilled cores shall be obtained and tested in conformance with ASTM C 42. The tests shall be conducted by a materials testing consultant approved by the Engineer.

c. The location from which each core is taken shall be approved by the Engineer. Each core specimen shall be located, when possible, so its axis is perpendicular to the concrete surface and not near formed joints or obvious edges of a unit of deposit.

d. The core specimens shall be taken, if possible, so no reinforcing steel is within the confines of the core.

e. The diameter of core specimens should be at least 3 times the maximum nominal size of the course aggregate used in the concrete, but must be at least 2-inches in diameter.

f. The length of specimen, when capped, shall be at least twice the diameter of the specimen.

g. The core specimens shall be taken to the laboratory and when transported, shall not be thrown, dropped, allowed to roll, or damaged in any way.

h. Two (2) copies of test results shall be mailed directly to the Engineer. The concrete in question will be considered acceptable if the average compressive strength of a minimum of three test core specimens taken from a given area equal or exceed 85% of the specified 28-day strength and if the lowest core strength is greater than 75% of the specified 28-day strength.

3. In the event that concrete placed by the Contractor is suspected of not having proper air content, the Contractor shall engage a materials testing consultant approved by the Engineer, to obtain and test samples for air content in accordance with ASTM Specification C 457.

3.11 CARE AND REPAIR OF CONCRETE

A. The Contractor shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance by the County. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Care shall be exercised to avoid jarring forms or placing any strain on the ends of projecting reinforcing bars. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at no additional cost to the County.

B. Areas of honeycomb shall be chipped back to sound concrete and repaired as directed.

C. Concrete formwork blowouts or unacceptable deviations in tolerances for formed surfaces due to improperly constructed or misaligned formwork shall be repaired as directed. Bulging or protruding areas, which result from slipping or deflecting forms shall be ground flush or chipped out and redressed as directed.

D. Areas of concrete in which cracking, spalling, or other signs of deterioration develop prior to final acceptance shall be removed and replaced, or repaired as directed. This stipulation includes concrete that has experienced cracking due to drying or thermal shrinkage of the concrete. Structural cracks shall be repaired using an approved epoxy injection system. Non-structural cracks shall be repaired using an approved hydrophilic resin pressure injected grout system, unless other means of repair are deemed necessary and approved. All repair work shall be performed at no additional cost to the County.

E. Concrete which fails to meet the strength requirements as outlined in Article 3.10, paragraph F, will be analyzed as to its adequacy based upon loading conditions,

resultant stresses and exposure conditions for the particular area of concrete in question. If the concrete in question is found unacceptable based upon this analysis, that portion of the structure shall be strengthened or replaced by the Contractor at no additional cost to the County. The method of strengthening or extent of replacement shall be as directed by the Engineer.

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SECTION 03350

CONCRETE FINISHES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide finishes of all concrete surfaces specified herein and shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03100 – Concrete Formwork

B. Section 03300 – Cast-in-Place Concrete

C. Section 03600 – Grout

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. ACI 301 – Specifications for Structural Concrete for Buildings

2. ACI 318 – Building Code Requirements for Structural Concrete

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01300 – Submittals.

1. Manufacturer's literature on all products specified herein.

PART 2 -- PRODUCTS

2.01 CONCRETE FLOOR SEALER

A. Floor sealer shall be Diamond Clear VOX or Super Diamond Clear VOX by the Euclid Chemical Company, MasterKure CC 300 SB by BASF Master Builder Solutions.

2.02 CONCRETE LIQUID DENSIFIER AND SEALANT

A. Concrete liquid densifier and sealant shall be a high performance, deeply penetrating concrete densifier and sealant. Product shall be odorless, colorless, VOC-compliant, non-yellowing siliconate based solution designed to harden, dustproof and protect concrete floors subjected to heavy vehicular traffic and to resist black rubber tire marks on concrete surfaces. The product must contain a minimum solids content of 20% of which 50% is siliconate. Acceptable products are Diamond Hard by the Euclid Chemical Company, Seal Hard by L&M Construction Chemicals and MasterKure HD 210 WB by BASF Master Builder Solutions.

2.03 NON-METALLIC FLOOR HARDENER

A. The specified non-metallic mineral aggregate hardener shall be formulated, processed, and packaged under stringent quality control at the manufacturer's owned and controlled factory. The hardener shall be a factory-blended mixture of specifically processed graded mineral aggregate, selected Portland cement, and necessary plasticizing agents. Acceptable products shall be "Surflex" by the Euclid Chemical Company, "Harcol" by Sonneborn, "Maximent" by BASF, and "Mastercon" by BASF.

2.04 NON-OXIDIZING HEAVY DUTY METALLIC FLOOR HARDENER

A. Non-oxidizing heavy duty metallic floor hardener shall be formulated, processed, and packaged under stringent quality control at the manufacturer's owned and controlled factory. The hardener shall be a mixture of specifically processed non-rusting aggregate, selected Portland cement, and necessary plasticizing agents. Product shall be "Diamond-Plate" by the Euclid Chemical Company, or Masterplate by BASF Construction Chemicals.

2.05 NON-SLIP FLOORING ADDITIVE

A. Non-slip flooring additives for slip resistant floors shall be non-metallic. Non-slip flooring additives shall be Frictex NS by BASF Construction Chemicals, A-H Alox by Anti-Hydro, or Euco Grip by the Euclid Chemical Company.

PART 3 -- EXECUTION

3.01 FINISHES ON FORMED CONCRETE SURFACES

A. After removal of forms, the finishes described below shall be applied in accordance with Article 3.05 - Concrete Finish Schedule. Unless the finish schedule specifies otherwise, all surfaces shall receive at least a Type I finish. The Engineer shall be the sole judge of acceptability of all concrete finish work.

1. Type I - Rough: All fins, burrs, offsets, marks and all other projections left by the forms shall be removed. Projections, depressions, etc. below finished grade required to be removed will only be those greater than ¼-inch. All holes left by removal of ends of ties, and all other holes, depressions, bugholes, air/blow holes or voids shall be filled solid with cement grout after first being thoroughly wetted and then struck off flush. The only holes below grade to be filled will be

tie holes and any other holes larger than ¼-inch in any dimension. Honeycombs shall be chipped back to solid concrete and repaired as directed by the Engineer. All holes shall be filled with tools, such as sponge floats and trowels, that will permit packing the hole solidly with cement grout. Cement grout shall consist of one part cement to three parts sand, epoxy bonding agent (for tie holes only) and the amount of mixing water shall be as little as consistent with the requirements of handling and placing. Color of cement grout shall match the adjacent wall surface.

2. Type II - Grout Cleaned: Where this finish is required, it shall be applied after completion of Type I finish. After the concrete has been predampened, a slurry consisting of one part cement (including an appropriate quantity of white cement in order to produce a color matching the surrounding concrete) and 1-1/2 parts sand passing the No. 16 sieve, by damp loose volume, shall be spread over the surface with clean burlap pads or sponge rubber floats. Mix proportions shall be submitted to the Engineer after a sample of the work is established and accepted. Any surplus shall be removed by scraping and then rubbing with clean burlap.

3. Type III - Smooth Rubbed: Where this finish is required, it shall be applied after the completion of the Type II finish. No rubbing shall be done before the concrete is thoroughly hardened and the mortar used for patching is firmly set. A smooth, uniform surface shall be obtained by wetting the surface and rubbing it with a carborundum stone to eliminate irregularities. Unless the nature of the irregularities requires it, the general surface of the concrete shall not be cut into. Corners and edges shall be slightly rounded by the use of the carborundum stone. Brush finishing or painting with grout or neat cement will not be permitted. A 100 square foot example shall be established at the beginning of the project to establish acceptability.

3.02 SLAB AND FLOOR FINISHES

A. The finishes described below shall be applied to floors, slabs, flow channels and top of walls in accordance with Article 3.05 - Concrete Finish Schedule. The Engineer shall be the sole judge of acceptability of all such finish work.

1. Type "A" - Screeded: This finish shall be obtained by placing screeds at frequent intervals and striking off to the surface elevation required. When a Type "F" finish is subsequently to be applied, the surface of the screeded concrete shall be roughened with a concrete rake to 1/2” minimum deep grooves prior to final set.

2. Type "B" - Wood or Magnesium Floated: This finish shall be obtained after completion of a Type "A" finish by working a previously screeded surface with a wood or magnesium float or until the desired texture is reached. Floating shall begin when the water sheen has disappeared and when the concrete has sufficiently hardened so that a person's foot leaves only a slight imprint. If wet spots occur, water shall be removed with a squeegee. Care shall be taken to prevent the formation of laitance and excess water on the finished surface. All

edges shall be edged with an 1/8-inch tool as directed by the Engineer. The finished surface shall be true, even, and free from blemishes and any other irregularities.

3. Type "C" - Cork Floated: This finish shall be similar to Type "B" but slightly smoother than that obtained with a wood float. It shall be obtained by power or band floating with cork floats.
4. Type "D" - Steel Troweled: This finish shall be obtained after completion of a Type "B" finish. When the concrete has hardened sufficiently to prevent excess fine material from working to the surface, the surface shall be compacted and smoothed with not less than two thorough and complete steel troweling operations. In areas which are to receive a floor covering such as tile, resilient flooring, or carpeting, the applicable Specification Sections and Contract Drawings shall be reviewed for the required finishes and degree of flatness. In areas that are intermittently wet such as pump rooms, only one troweling operation is required to provide some trowel marks for slip resistance. All edges shall be edged with an 1/8-inch tool as directed by the Engineer. The finish shall be brought to a smooth, dense surface, free from defects and blemishes.

5. Type "E" - Broom or Belt: This finish shall provide the surface with a transverse scored texture by drawing a broom or burlap belt across the surface immediately after completion of a Type "B" finish. All edges shall be edged with an 1/8-inch tool as directed by the Engineer.

6. Type "F" - Swept in Grout Topping: This finish shall be applied after a completion of a Type "A" finish. The concrete surface shall be properly cleaned, washed, and coated with a mixture of water and Portland Cement. Cement grout in accordance with Section 03600 shall then be plowed and swept into neat conformance with the blades or arms of the apparatus by turning or rotating the previously positioned mechanical equipment. Special attention shall be paid to true grades, shapes and tolerances as specified by the manufacturer of the equipment. Before beginning this finish, the Contractor shall notify the Engineer and the equipment manufacturer of the details of the operation and obtain approval and recommendations.

7. Type “G” Hardened Finish: This finish shall be applied after completion of a Type “B” or Type “C” finish and prior to application of a Type “D” finish. Hardeners shall be applied in strict accordance with the manufacturer’s requirements. Hardeners shall be applied using a mechanical spreader. The hardener shall be applied in two shakes with the first shake comprising 2/3 of the total amount. Type “D” finish shall be applied following completion of application of the hardener.

    a. Non-metallic floor hardener shall be applied where specifically required on the Contract Drawings at the rate of 1.0 pounds/ft.^{2}.

    b. Non-oxidizing heavy duty metallic floor hardener shall be applied at the loading docks and where specifically required on the Contract Drawings or specified herein at the rate of 1.5 pounds/ft.^{2}.

8. Type "H" - Non-Slip Finish: This finish shall be provided by applying a non-slip flooring additive concurrently with the application of a Type "D" finish and/or installation of floor sealants. Application procedure shall be in accordance with manufacturer's instructions. Finish shall be applied where specifically required on the Contract Drawings or specified herein.

9. Type "J" - Raked Finish: This finish shall be provided by raking the surface as soon as the condition of the concrete permits by making depressions of ±1/4 inch.

3.03 CONCRETE SEALERS

A. Concrete sealers shall be applied where specifically required on the Contract Drawings or specified herein.

B. Sealers shall be applied after installation of all equipment, piping, etc. and after completion of any other related construction activities. Application of sealers shall be in strict accordance with manufacturer’s requirements.

C. Sealers shall be applied to all floor slabs not painted and not intended to be immersed.

D. Floor slabs subjected to vehicular traffic shall be sealed with the concrete liquid densifier and sealer.

E. All other floor slabs to receive sealer shall be sealed with concrete floor sealer.

3.04 FINISHES ON EQUIPMENT PADS

A. Formed surfaces of equipment pads shall receive a Type III finish.

B. Top surfaces of equipment pads, except those surfaces subsequently required to receive grout and support equipment bases, shall receive a Type "D" finish, unless otherwise noted. Surfaces which will later receive grout shall, before the concrete takes its final set, be made rough by removing the sand and cement that accumulates on the top to the extent that the aggregate will be exposed with irregular indentations in the surface up to 1/2 inch deep.

3.05 CONCRETE FINISH SCHEDULE

Item	Type of Finish
Concrete surfaces indicated to receive textured coating	I
Inner face of walls of tanks, flow channels, wet wells, perimeter walls, and miscellaneous concrete structures:	
From 1 feet below water surface to bottom of wall	I
From top of wall to 1 feet below water surface	II

Item	Type of Finish
Exterior concrete walls below grade	I
Exterior exposed concrete walls, ceilings, beams, manholes, hand holes, miscellaneous structures and columns (including top of wall) to one foot below grade. All other exposed concrete surfaces not specified elsewhere	II
Floors of process equipment tanks or basins, wetwells, flow channels and slabs to receive roofing material or waterproof membranes	B
Exterior concrete sidewalks, steps, ramps, decks, slabs on grade and landings exposed to weather	E
Floors of process equipment tanks indicated on Drawings to receive grout topping	F

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SECTION 03370

CONCRETE CURING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Protect all freshly deposited concrete from premature drying and from the weather elements. The concrete shall be maintained with minimal moisture loss at a relatively constant temperature for a period of time necessary for the hydration of the cement and proper hardening of the concrete in accordance with the requirements specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03100 – Concrete Formwork

B. Section 03300 – Cast-In-Place Concrete

C. Section 03350 – Concrete Finishes

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. ACI 301 – Specifications for Structural Concrete for Buildings

2. ACI 304 – Guide for Measuring, Mixing, Transporting, and Placing Concrete

3. ACI 305 – Hot Weather Concreting

4. ACI 306 – Cold Weather Concreting

5. ACI 308 – Standard Practice for Curing Concrete

6. ASTM C171 – Standard Specifications for Sheet Materials for Curing Concrete

7. ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

8. ASTM C1315 – Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01300, Submittals.

1. Proposed procedures for protection of concrete under wet weather placement conditions.

2. Proposed normal procedures for protection and curing of concrete.

3. Proposed special procedures for protection and curing of concrete under hot and cold weather conditions.

4. Proposed method of measuring concrete surface temperature changes.

5. Manufacturer's literature and material certification for proposed curing compounds.

PART 2 -- PRODUCTS

2.01 LIQUID MEMBRANE-FORMING CURING COMPOUND

A. Clear curing and sealing compound shall be a clear styrene acrylate type complying with ASTM C 1315, Type 1, Class A with a minimum solids content of 30%. Moisture loss shall not be greater than 0.40 kg/m^2 when applied at 300 sq.ft./gal. Manufacturer's certification is required. Acceptable products are Super Diamond Clear VOX by the Euclid Chemical Company, MasterKure CC 300 SB by BASF Master Builder Solutions, and Cure & Seal 30 Plus by Symons Corporation.

B. Where specifically approved by Engineer, on slabs to receive subsequent applied finishes, compound shall conform to ASTM C 309. Acceptable products are "Kurez DR VOX" or "Kurez W VOX" by the Euclid Chemical Company. Install in strict accordance with manufacturer's requirements.

2.02 EVAPORATION REDUCER

A. Evaporation reducer shall be BASF, "MasterKure ER 50", or Euclid Chemical "Euco-Bar".

PART 3 -- EXECUTION

3.01 PROTECTION AND CURING

A. All freshly placed concrete shall be protected from the elements, flowing water and from defacement of any nature during construction operations.

B. As soon as the concrete has been placed and horizontal top surfaces have received their required finish, provision shall be made for maintaining the concrete in a moist condition for at least a 5-day period thereafter except for high early strength concrete,

for which the period shall be at least the first three days after placement. Horizontal surfaces shall be kept covered, and intermittent, localized drying will not be permitted.

C. Walls that will be exposed on one side with either fluid or earth backfill on the opposite side shall be continuously wet cured for a minimum of five days. Use of a curing compound will not be acceptable for applications of this type.

D. The Contractor shall use one of the following methods to insure that the concrete remains in a moist condition for the minimum period stated above.

1. Ponding or continuous fogging or sprinkling.

2. Application of mats or fabric kept continuously wet.

3. Continuous application of steam (under 150°F).

4. Application of sheet materials conforming to ASTM C171.

5. If approved by the Engineer, application of a curing compound in accordance with Article 3.04.

E. The Contractor shall keep absorbent wood forms wet until they are removed. After form removal, the concrete shall be cured by one of the methods in paragraph D.

F. Any of the curing procedures used in Paragraph 3.01-D may be replaced by one of the other curing procedures listed in Paragraph 3.01-D after the concrete is one-day old. However, the concrete surface shall not be permitted to become dry at any time.

3.02 CURING CONCRETE UNDER COLD WEATHER CONDITIONS

A. Suitable means shall be provided for a minimum of 72 hours after placing concrete to maintain it at or above the minimum as placed temperatures specified in Section 03300, Cast-In-Place Concrete, for concrete work in cold weather. During the 72-hour period, the concrete surface shall not be exposed to air more than 20°F above the minimum as placed temperatures.

B. Stripping time for forms and supports shall be increased as necessary to allow for retardation in concrete strength caused by colder temperatures. This retardation is magnified when using concrete made with blended cements or containing fly ash or ground granulated blast furnace slag. Therefore, curing times and stripping times shall be further increased as necessary when using these types of concrete.

C. The methods of protecting the concrete shall be approved by the Engineer and shall be such as will prevent local drying. Equipment and materials approved for this purpose shall be on the site in sufficient quantity before the work begins. The Contractor shall assist the Engineer by providing holes in the forms and the concrete in which thermometers can be placed to determine the adequacy of heating and protection. All such thermometers shall be furnished by the Contractor in quantity and type which the Engineer directs.

D. Curing procedures during cold weather conditions shall conform to the requirements of ACI 306.

3.03 CURING CONCRETE UNDER HOT WEATHER CONDITIONS

A. When air temperatures exceed 85°F, the Contractor shall take extra care in placing and finishing techniques to avoid formation of cold joints and plastic shrinkage cracking. If ordered by the Engineer, temporary sun shades and/or windbreakers shall be erected to guard against such developments, including generous use of wet burlap coverings and fog sprays to prevent drying out of the exposed concrete surfaces.

B. Immediately after screeding, horizontal surfaces shall receive an application of evaporation reducer. Apply in accordance with manufacturer's instructions. Final finish work shall begin as soon as the mix has stiffened sufficiently to support the workmen.

C. Curing and protection of the concrete shall begin immediately after completion of the finishing operation. Continuous moist-curing consisting of method 1 or 2 listed in paragraph 3.01D is mandatory for at least the first 24 hours. Method 2 may be used only if the finished surface is not marred or blemished during contact with the coverings.

D. At the end of the initial 24-hour period, curing and protection of the concrete shall continue for at least six (6) additional days using one of the methods listed in paragraph 3.01D.

E. Curing procedures during hot weather conditions shall conform to the requirements of ACI 305.

3.04 USE OF CURING COMPOUND

A. Curing compound shall be used only where specifically approved by the Engineer. Curing compound shall never be used for curing exposed walls with fluid or earth backfill on the opposite side. A continuous wet cure for a minimum of five days is required for these applications. Curing compound shall not be used on surfaces exposed to water in potable water storage tanks and treatment plants unless curing compound is certified in accordance with ANSI/NSF Standard 61.

B. When permitted, the curing compound shall maintain the concrete in a moist condition for the required time period, and the subsequent appearance of the concrete surface shall not be affected.

C. The compound shall be applied in accordance with the manufacturer's recommendations after water sheen has disappeared from the concrete surface and after finishing operations. Maximum coverage for the curing and sealing compound shall be 300 square feet per gallon for trowel finishes and 200 square feet per gallon for floated or broom surfaces. Maximum coverage for compounds placed where subsequent finishes will be applied shall be 200 square feet per gallon. For rough surfaces, apply in two directions at right angles to each other.

3.05 EARLY TERMINATION OF CURING

A. Moisture retention measures may be terminated earlier than the specified times only when at least one of the following conditions is met:

1. The strength of the concrete reaches 85 percent of the specified 28-day compressive strength in laboratory-cured cylinders representative of the concrete in place, and the temperature of the in-place concrete has been constantly maintained at 50 degrees Fahrenheit or higher.

2. The strength of concrete reaches the specified 28-day compressive strength as determined by accepted nondestructive methods or laboratory-cured cylinder test results.

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SECTION 03400

PRECAST CONCRETE

PART 1 -- GENERAL

1.01 REQUIREMENTS

A. The Contractor shall construct all precast concrete items as required in the Contract Documents, including all appurtenances necessary to make a complete installation.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02604 - Utility Structures

B. Section 03200 - Reinforcing Steel

C. Section 03230 - Stressing Tendons

D. Section 03300 - Cast-in-Place Concrete

E. Section 03350 - Concrete Finishes

F. Section 03370 - Concrete Curing

G. Section 03600 - Grout

H. Section 05010 - Metal Materials

I. Section 05035 - Galvanizing

J. Section 05050 - Metal Fastening

K. Section 05830 - Bearing Devices

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the end of the Bid.

1. Florida Building Code 6th Edition (2017)

2. ACI 318 - Building Code Requirements for Structural Concrete

3. PCI Standard MNL-116 - Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products

4. PCI Design Handbook

1.04 SUBMITTALS

A. The Contractor shall submit the following for review in accordance with Section 01300, Submittals.

1. Shop drawings for all precast concrete items showing all dimensions, locations, and type of lifting inserts, and details of reinforcement and joints.

2. A list of the design criteria used by the manufacturer for all manufactured, precast items.

3. Design calculations, showing at least the design loads and stresses on the item, shall be submitted. Calculations shall be signed and sealed by a Professional Engineer registered in the State of Florida.

4. Certified reports for all lifting inserts, indicating allowable design loads.

5. Information on lifting and erection procedures.

1.05 QUALITY ASSURANCE

A. All manufactured precast concrete units shall be produced by an experienced manufacturer regularly engaged in the production of such items. All manufactured precast concrete and site-cast units shall be free of defects, spalls, and cracks. Care shall be taken in the mixing of materials, casting, curing and shipping to avoid any of the above. The Engineer may elect to examine the units at the casting yard or upon arrival of the same at the site. The Engineer shall have the option of rejecting any or all of the precast work if it does not meet with the requirements specified herein or on the Drawings. All rejected work shall be replaced at no additional cost to the County.

B. Manufacturer Qualifications

The precast concrete manufacturing plant shall be certified by the Prestressed Concrete Institute, Plant Certification Program, prior to the start of production. Certification is only required for plants providing prestressed structural members such as hollow core planks, double-T members, etc.

C. Plant production and engineering must be under direct supervision and control of an Engineer who possesses a minimum of five years experience in precast concrete work.

PART 2 -- PRODUCTS

2.01 CONCRETE

A. Concrete materials including portland cement, aggregates, water, and admixtures shall conform to Section 03300, Cast-in-Place Concrete.

B. For prestressed concrete items, minimum compressive strength of concrete at 28 days shall be 5,000 psi unless otherwise specified. Minimum compressive strength of concrete at transfer of prestressing force shall be 3,500 psi unless otherwise specified.

C. For non-prestressed concrete items, minimum compressive strength of concrete at 28 days shall be 4000 psi unless otherwise specified.

2.02 GROUT

A. Grout for joints between panels shall be a cement grout in conformance with Section 03600, Grout.

B. Minimum compressive strength of grout at 7 days shall be 3,000 psi.

2.03 REINFORCING STEEL

A. Reinforcing steel used for precast concrete construction shall conform to Section 03200, Reinforcing Steel.

2.04 PRESTRESSING STRANDS

A. Prestressing strands shall be 7-wire, stress-relieved, high-strength strands Grade 250K or 270K in conformance with Section 03230, Stressing Tendons.

2.05 STEEL INSERTS

A. Steel inserts shall be in accordance with Section 05010, Metal Materials.

B. All steel inserts protruding from or occurring at the surface of precast units shall be galvanized in accordance with Section 05035, Galvanizing.

2.06 WELDING

A. Welding shall conform to Section 05050, Metal Fastening.

2.07 BEARING PADS

A. Neoprene bearing pads shall conform to Section 05830, Bearing Devices and Anchors.

B. Plastic bearing pads shall be multi-monomer plastic strips which are non-leaching and support construction loads with no visible overall expansion, manufactured specifically for the purpose of bearing precast concrete.

PART 3 -- EXECUTION

3.01 FABRICATION AND CASTING

A. All precast members shall be fabricated and cast to the shapes, dimensions and lengths shown on the Drawings and in compliance with PCI MNL-116. Precast members shall be straight, true and free from dimensional distortions, except for camber and tolerances permitted later in this clause. All integral appurtenances, reinforcing, openings, etc., shall be accurately located and secured in position with the form work system. Form materials shall be steel and the systems free from leakage during the casting operation.

B. All cover of reinforcing shall be the same as detailed on the Drawings.

C. Because of the critical nature of the bond development length in prestressed concrete panel construction, if the transfer of stress is by burning of the fully tensioned strands at the ends of the member, each strand shall first be burned at the ends of the bed and then at each end of each member before proceeding to the next strand in the burning pattern.

D. The Contractor shall coordinate the communication of all necessary information concerning openings, sleeves, or inserts to the manufacturer of the precast members.

E. Concrete shall be finished in accordance with Section 03350, Concrete Finishes. Grout all recesses due to cut tendons which will not otherwise be grouted during erection.

F. Curing of precast members shall be in accordance with Section 03370, Concrete Curing. Use of a membrane curing compound will not be allowed.

G. The manufacturer shall provide lifting inserts or other approved means of lifting members.

3.02 HANDLING, TRANSPORTING AND STORING

A. Precast members shall not be transported away from the casting yard until the concrete has reached the minimum required 28 day compressive strength and a period of at least 5 days has elapsed since casting, unless otherwise permitted by the Engineer.

B. No precast member shall be transported from the plant to the job site prior to approval of that member by the plant inspector. This approval will be stamped on the member by the plant inspector.

C. During handling, transporting, and storing, precast concrete members shall be lifted and supported only at the lifting or supporting points as indicated on the shop drawings.

D. All precast members shall be stored on solid, unyielding, storage blocks in a manner to prevent torsion, objectionable bending, and contact with the ground.

E. Precast concrete members shall not be used as storage areas for other materials or equipment.

F. Precast members damaged while being handled or transported will be rejected or shall be repaired in a manner approved by the Engineer.

3.03 ERECTION

A. Erection shall be carried out by the manufacturer or under his supervision using labor, equipment, tools and materials required for proper execution of the work.

B. Contractor shall prepare all bearing surfaces to a true and level line prior to erection. All supports of the precast members shall be accurately located and of required size and bearing materials.

C. Installation of the precast members shall be made by leveling the top surface of the assembled units keeping the units tight and at right angles to the bearing surface.

D. Connections which require welding shall be properly made in accordance with Section 05050, Metal Fastening.

E. Grouting between adjacent precast members and along the edges of the assembled precast members shall be accomplished as indicated on the drawings, care being taken to solidly pack such spaces and to prevent leakage or droppings of grout through the assembled precast members. Any grout which seeps through the precast members shall be removed before it hardens.

F. In no case shall concentrated construction loads, or construction loads exceeding the design loads, be placed on the precast members. In no case shall loads be placed on the precast members prior to the welding operations associated with erection, and prior to placing of topping (if required).

G. No Contractor, Subcontractor or any of his employees shall arbitrarily cut, drill, punch or otherwise tamper with the precast members.

H. Precast members damaged while being erected will be rejected or shall be repaired in a manner approved by the Engineer.

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SECTION 03480

PRECAST CONCRETE SPECIALTIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish all materials, labor, equipment, and tools required for the design, fabrication, delivery, and installment of precast concrete manhole vaults and meter box structures in accordance with the Drawings and as specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03400 - Precast Concrete

1.03 SUBMITTALS

A. The Contractor shall submit samples and/or shop drawings in accordance with Section 01300, Submittals.

B. In addition to items listed in Section 03400, shop drawings shall include, but not be limited to:

1. Piping and conduit sheets.

2. Complete layout and installation drawings and schedules with clearly marked dimensions.

1.04 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Federal Specification No. SS-5-00210

2. ASTM C478 - Specification for Precast Reinforced Concrete Manhole Sections

PART 2 -- PRODUCTS

2.01 PRECAST MANHOLES, VAULTS, AND METER BOXES

A. Precast concrete manholes shall be furnished with waterstops, sleeves and openings as noted on the Drawings. Box out for wall pipes shall conform accurately to the sizes and

elevations of the adjoining pipes. Precast manholes shall be watertight and conform to the requirements of ASTM C478 with reinforcing steel of ASTM A615, Grade 60 bars and the following modifications there to:

1. Materials shall conform to Section 03400, Precast Concrete.

2. The minimum wall thickness shall be 8 inches.

3. The date and time of manufacturer shall be marked inside each precast sections.

4. No more than two lift holes may be cast or drilled in each section.

5. Dimensions shall be as shown on the Drawings.

6. Vault covers and frames shall comply with Section 05500, Metal Fabrications. The frames and covers shall be provided by the vault manufacturer. Covers shall have lifting handles and shall be bolted with stainless steel bolts complying with Section 05050, Metal Fastening. When leveling bolts are used to set the vault top sections, the Contractor shall ensure that the load on the vault will be transferred through the mortar to the vault, and will not be carried by the leveling bolts.

7. Mechanical details such as piping, electrical, and other details shall be as shown on the Drawings.

B. Joints between manhole riser sections and at base slabs shall be groove type. Joints shall be sealed with two (2) individual self sealing butyl rubber gaskets conforming to Federal Specification No. SS-5-00210. The gasket material shall be Kent Seal.

2.02 PIPE CONNECTIONS

A. The precast reinforced concrete manhole base shall be provided with circular openings at the locations and elevations for the proper connection of all pipes. The pipe connections shall be sealed with either a flexible manhole seal assembly or with mortar.

B. When a flexible manhole seal assembly is used to seal the pipe connection, the seal assembly shall be installed in accordance with the recommendations of the seal assembly manufacturer and shall conform to ASTM C923.

C. Flexible manhole seal assemblies shall permit at least an eight (8) degree deflection from the center line of the opening in any direction while maintaining a watertight connection.

D. The flexible manhole seal assembly shall be manufactured by Interpace Corp (Lock Joint Flexible Manhole Sleeve), National Pollution Control Systems, Inc. (Kor-N-Seal) or Press-Seal Gasket Corp. Manhole seal assemblies produced by other manufacturers will be considered for use by Engineer if submitted by the Contractor. Such manhole seal assemblies shall be acceptable only if the Shop Drawings are approved.

E. Short lengths of sewer pipe shall be installed entering and leaving the precast manhole base. These short lengths of pipe shall have a maximum length of 3'3". A concrete cradle shall be placed under the short length of pipe in accordance with the dimensions shown on the Drawings.

F. The concrete cradle is not necessary when a flexible manhole seal assembly is used.

2.03 MANHOLE LADDERS

A. Manhole ladders shall conform to Section 06610, Glass Fiber and Resin Fabrications.

PART 3 -- EXECUTION

3.01 DESIGN CRITERIA

A. Precast items subjected to vehicular traffic shall be designed for H-20 traffic loading. Other precast items shall be designed for a vertical live load of 300 psf.

B. Walls of precast items shall be designed for a vertical surcharge of 100 psf.

3.02 MANUFACTURED ITEMS

A. Precast concrete manhole sections shall be set so as to be vertical, with sections in true alignment. The joint of the previously set section shall be covered with mortar and preformed joint sealant before the next section is placed. Before the mortar is set, joints shall be pointed, and exterior joints shall be thoroughly tooled so as to be slightly concave with a hard polished surface, free of cracks. Interior joints shall be tooled flush in a similar manner.

B. Precast wall sections shall be of such lengths as will permit the setting of the manhole frame for the required elevation on two or three courses of brick masonry laid around the top of the upper section. Such brick work shall be given a 1-inch mortar coat on the inside and outside.

C. Precast items shall be installed in accordance with the manufacturer's recommendations, unless otherwise required by the Drawings.

3.03 MANHOLE LADDERS

A. The ladder shall be installed so bottom of ladder rests on or in the concrete shelf of the invert fill. The bottom step shall not interfere with piping. Angle brackets shall be spaced a maximum of 6 feet apart, with a minimum to two brackets per ladder section. The anchor bolts shall not be located within 12 inches of any joint in the manhole sections. Ladders shall be installed in conformance with the Drawings.

- END OF SECTION -

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SECTION 03600

GROUT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all grout used in concrete work and as bearing surfaces for base plates, in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Requirements of related work are included in Division 1 and Division 2 of these Specifications.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1.	CRD-C 621	Corps of Engineers Specification for Non-shrink Grout
2.	ASTM C 109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch or 50 mm cube Specimens)
3.	ASTM C 531	Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts and Monolithic Surfacings
4.	ASTM C 579	Test Method for Compressive Strength of Chemical-Resistant Mortars and Monolithic Surfacings
5.	ASTM C 827	Standard Test Method for Early Volume Change of Cementitious Mixtures
6.	ASTM C 144	Standard Specification for Aggregate for Masonry Mortar
7.	ASTM C 1107	Standard Specification for Packaged Dry, Hydraulic Cement Grout (Nonshrink)

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01300 - Submittals.

1. Certified test results verifying the compressive strength and shrinkage and expansion requirements specified herein.

2. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of grout used in the work.

1.05 QUALITY ASSURANCE

A. Field Tests

1. Compression test specimens will be taken during construction from the first placement of each type of grout and at intervals thereafter as selected by the Engineer to insure continued compliance with these Specifications. The specimens will be made by the Engineer or its representative.

a. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed as specified in ASTM C 109 at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven days, 28 days and any additional time period as appropriate.

b. Compression tests and fabrication of specimens for epoxy grout will be performed as specified in ASTM C 579, Method B, at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven days and any other time period as appropriate.

2. The cost of all laboratory tests on grout will be borne by the County, but the Contractor shall assist the Engineer in obtaining specimens for testing. The Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the specifications. The Contractor shall supply all materials necessary for fabricating the test specimens, at no additional cost to the County.

3. All grout, already placed, which fails to meet the requirements of these Specifications, is subject to removal and replacement at no additional cost to the County.

PART 2 -- PRODUCTS

2.01 MATERIALS

A. Cement Grout

1. Cement grout shall be composed of Portland Cement and sand in the proportion specified in the Contract Documents and the minimum amount of water necessary to obtain the desired consistency. If no proportion is indicated, cement grout shall consist of one part Portland Cement to three parts sand. Water amount shall be as required to achieve desired consistency without compromising strength requirements. White Portland Cement shall be mixed with the Portland Cement as required to match color of adjacent concrete.

2. The minimum compressive strength at 28 days shall be 4000 psi.

3. For beds thicker than 1½ inch and/or where free passage of grout will not be obstructed by coarse aggregate, 1½ parts of coarse aggregate having a top size of 3/8 inch should be added. This stipulation does not apply for grout being swept in by a mechanism. These applications shall use a plain cement grout without coarse aggregate regardless of bed thickness.

4. Sand shall conform to the requirements of ASTM C144.

B. Non-Shrink Grout

1. Non-shrink grout shall conform to CRD-C 621 and ASTM C 1107, Grade B or C when tested at a max. fluid consistency of 30 seconds per CDC 611/ASTM C939 at temperature extremes of 45°F and 90°F and an extended working time of 15 minutes. Grout shall have a min. 28-day strength of 7,000 psi. Non-shrink grout shall be, "Euco N-S" by the Euclid Chemical Company, "Sikagrout 212" by Sika Corporation, “Conspec 100 Non-Shrink Non-Metallic Grout” by Conspec, “Masterflow 555 Grout” by BASF Master Builder Solutions.

C. Epoxy Grout

1. Epoxy grout shall be "Sikadur 32 Hi-Mod" by Sika Corporation, "Duralcrete LV" by Tamms Industries, or "Euco #452 Series" by Euclid Chemical, “MasterEmaco ADH 1090 RS” by BASF Master Builder Solutions.

2. Epoxy grout shall be modified as required for each particular application with aggregate per manufacturer's instructions.

D. Epoxy Base Plate Grout

1. Epoxy base plate grout shall be “Sikadur 42, Grout-Pak” by Sika Corporation, or “Masterflow 648” by BASF Master Builder Solutions.

2.02 CURING MATERIALS

A. Curing materials shall be as specified in Section 03370, Concrete Curing for cement grout and as recommended by the manufacturer for prepackaged grouts.

PART 3 -- EXECUTION

3.01 GENERAL

A. The different types of grout shall be used for the applications stated below unless noted otherwise in the Contract Documents. Where grout is called for in the Contract Documents which does not fall under any of the applications stated below, non-shrink grout shall be used unless another type is specifically referenced.

1. Cement grout shall be used for grout toppings and for patching of fresh concrete.

2. Non-shrink grout shall be used for grouting beneath base plates of structural metal framing.

3. Epoxy grout shall be used for bonding new concrete to hardened concrete.

4. Epoxy base plate grout shall be used for precision seating of base plates including base plates for all equipment such as engines, mixers, pumps, vibratory and heavy impact machinery, etc.

B. New concrete surfaces to receive cement grout shall be as specified in Section 03350, Concrete Finishes, and shall be cleaned of all dirt, grease and oil-like films. Existing concrete surfaces shall likewise be cleaned of all similar contamination and debris, including chipping or roughening the surface if a laitance or poor concrete is evident. The finish of the grout surface shall match that of the adjacent concrete. Curing and protection of cement grout shall be as specified in Section 03370, Concrete Curing.

C. All mixing, surface preparation, handling, placing, consolidation, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

D. The Contractor, through the manufacturer of a non-shrink grout and epoxy grout, shall provide on-site technical assistance upon request, at no additional cost to the County.

3.02 CONSISTENCY

A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow.

3.03 MEASUREMENT OF INGREDIENTS

A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurement shall not be allowed.

B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

3.04 GROUT INSTALLATION

A. Grout shall be placed quickly and continuously, shall completely fill the space to be grouted and be thoroughly compacted and free of air pockets. The grout may be poured in place, pressure grouted by gravity, or pumped. The use of pneumatic pressure or dry-packed grouting requires approval of the Engineer. For grouting beneath base plates, grout shall be poured from one side only and thence flow across to the open side to avoid air-entrapment.

- END OF SECTION -

DIVISION 5

Metals

SECTION 05010

METAL MATERIALS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Metal materials not otherwise specified shall conform to the requirements of this Section.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Materials for fasteners are included in Section 05050, Metal Fastening.

B. Requirements for specific products made from the materials specified herein are included in other sections of the Specifications. See the section for the specific item in question.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. ASTM A36 Standard Specification for Structural Steel

B. ASTM A47 Standard Specification for Malleable Iron Castings

C. ASTM A48 Standard Specification for Gray Iron Castings

D. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

E. ASTM A167 Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

F. ASTM A276 Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes

G. ASTM A307 Standard Specification for Carbon Steel Externally Threaded Standard Fasteners

H. ASTM A446 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) quality

I. ASTM A500 Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

J. ASTM A501 Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

K. ASTM A529 Standard Specification for Structural Steel with 42 000 psi (290 Mpa) Minimum Yield Point (1/2 in. (12.7 mm) Maximum Thickness)

L. ASTM A536 Standard Specification for Ductile Iron Castings

M. ASTM A570 Standard Specification for Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality

N. ASTM A572 Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

O. ASTM A992 Standard Specification for Structural Steel Shapes

P. ASTM A666 Standard Specification for Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar for Structural Applications

Q. ASTM A1085 Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS)

R. ASTM B26 Standard Specification for Aluminum-Alloy Sand Castings

S. ASTM B85 Standard Specification for Aluminum-Alloy Die Castings

T. ASTM B108 Standard Specification for Aluminum-Alloy Permanent Mold Castings

U. ASTM B138 Standard Specification for Manganese Bronze Rod, Bar, and Shapes

V. ASTM B209 Standard Specification for Aluminum-Alloy Sheet and Plate

W. ASTM B221 Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

X. ASTM B308 Standard Specification for Aluminum-Alloy Standard Structural Shapes, Rolled or Extruded

Y. ASTM B574 Standard Specification for Nickel-Molybdenum-Chromium Alloy Rod

Z. ASTM F468 Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use

a. ASTM F593 Standard Specification for Stainless Steel Fasteners

1.04 SUBMITTALS

A. Material certifications shall be submitted along with any shop drawings for metal products and fabrications required by other sections of the Specifications.

1.05 QUALITY ASSURANCE

A. Owner may engage the services of a testing agency to test any metal materials for conformance with the material requirements herein. If the material is found to be in conformance with Specifications the cost of testing will be borne by the Owner. If the material does not conform to the Specifications, the cost of testing shall be paid by the Contractor and all materials not in conformance as determined by the Engineer shall be replaced by the Contractor at no additional cost to the Owner. In lieu of replacing materials the Contractor may request further testing to determine conformance, but any such testing shall be paid for by the Contractor regardless of outcome of such testing.

PART 2 -- PRODUCTS

2.01 CARBON AND LOW ALLOY STEEL

A. Material types and ASTM designations shall be as listed below:

1.	Steel W Shapes	A992
2.	Steel HP Shapes	A572 Grade 50
3.	Steel M, S, C, and MC shapes and Angles, Bars, and Plates	A36
4.	Rods	F 1554 Grade 36
5.	Pipe - Structural Use	A53 Grade B
6.	Hollow Structural Sections	A500 Grade C or A1085
7.	Cold-Formed Steel Framing	A 653

2.02 STAINLESS STEEL

A. All stainless steel fabrications exposed to underwater service shall be Type 316. All other stainless steel fabrications shall be Type 304, unless noted otherwise.

B. Material types and ASTM designations are listed below:

1.	Plates and Sheets	ASTM A167 or A666 Grade A
2.	Structural Shapes	ASTM A276
3.	Fasteners (Bolts, etc.)	ASTM F593

2.03 ALUMINUM

A. All aluminum shall be alloy 6061-T6, unless otherwise noted or specified herein.

B. Material types and ASTM designations are listed below:

1.	Structural Shapes	ASTM B308
2.	Castings	ASTM B26, B85, or B108
3.	Extruded Bars	ASTM B221 - Alloy 6061
4.	Extruded Rods, Shapes and Tubes	ASTM B221 - Alloy 6063
5.	Plates	ASTM B209 - Alloy 6061
6.	Sheets	ASTM B221 - Alloy 3003

C. All aluminum structural members shall conform to the requirements of Section 05140, Structural Aluminum.

D. All aluminum shall be provided with mill finish unless otherwise noted.

E. Where bolted connections are indicated, aluminum shall be fastened with stainless steel bolts.

F. Aluminum surfaces in contact with concrete or dissimilar metals shall be thoroughly protected with two coats of epoxy paint with a minimum total thickness of 16 mils or other approved isolating material in accordance with the requirements of Section 09900 - Painting.

2.04 CAST IRON

A. Material types and ASTM designations are listed below:

1.	Gray	ASTM A48 Class 30B
2.	Malleable	ASTM A47
3.	Ductile	ASTM A536 Grade 60-40-18

2.05 BRONZE

A. Material types and ASTM designations are listed below:

1.	Rods, Bars and Sheets	ASTM B138 - Alloy B Soft

2.06 HASTELLOY

A. All Hastelloy shall be Alloy C-276.

2.07 DISSIMILAR METALS

A. Dielectric isolation shall be installed wherever dissimilar metals are connected according to the following table.

	Zinc	Galvanized Steel	Aluminum	Cast Iron	Ductile Iron	Mild Steel/ Carbon Steel	Copper	Brass	Stainless Steel
Zinc			●	●	●	●	●	●	●
Galvanized Steel			●	●	●	●	●	●	●
Aluminum	●	●		●	●	●	●	●	●
Cast Iron	●	●	●				●	●	●
Ductile Iron	●	●	●				●	●	●
Mild Steel/ Carbon Steel	●	●	●				●	●	●
Copper	●	●	●	●	●	●			●
Brass	●	●	●	●	●	●			●
Stainless Steel	●	●	●	●	●	●	●	●	

1. "●" signifies dielectric isolation is required between the two materials noted.
2. Consult Engineer for items not listed in table.

PART 3 -- EXECUTION

(NOT USED)

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SECTION 05035

GALVANIZING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Where galvanizing is called for in the Contract Documents, the galvanizing shall be performed in accordance with the provisions of this Section unless otherwise noted.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Further requirements for galvanizing specific items may be included in other Sections of the Specifications. See section for the specific item in question.

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Building Code 6th Edition (2017)

2. ASTM A123 - Standard Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip

3. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

4. ASTM A653 - Standard Specification for Steel Sheet, Zinc Coated (Galvanized), or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

4. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

5. ASTM A780 - Standard Practice of Repair of Damaged Hot-Dip Galvanized Coatings

6. ASTM F2329 - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01300, Submittals.

1. Certification that the item(s) are galvanized in accordance with the applicable ASTM standards specified herein. This certification may be included as part of any material certification that may be required by other Sections of the Specifications.

PART 2 -- PRODUCTS

2.01 GALVANIC COATING

A. Material composition of the galvanic coating shall be in accordance with the applicable ASTM standards specified herein.

PART 3 -- EXECUTION

3.01 FABRICATED PRODUCTS

A. Products fabricated from rolled, pressed, and forged steel shapes, plates, bars, and strips, 1/8 inch thick and heavier which are to be galvanized shall be galvanized in accordance with ASTM A123. Products shall be fabricated into the largest unit which is practicable to galvanize before the galvanizing is done. Fabrication shall include all operations necessary to complete the unit such as shearing, cutting, punching, forming, drilling, milling, bending, and welding. Components of bolted or riveted assemblies shall be galvanized separately before assembly. When it is necessary to straighten any sections after galvanizing, such work shall be performed without damage to the zinc coating. The galvanizer shall be a member of American Galvanizers Association.

B. Components with partial surface finishes shall be commercial blast cleaned prior to pickling.

C. Sampling and testing of each lot shall be performed prior to shipment from the galvanizer's facility per ASTM A123.

3.02 HARDWARE

A. Iron and steel hardware which is to be galvanized shall be galvanized in accordance with ASTM A153 and ASTM F2329.

3.03 ASSEMBLED PRODUCTS

A. Assembled steel products which are to be galvanized shall be galvanized in accordance with ASTM A123. All edges of tightly contacting surfaces shall be completely sealed by welding before galvanizing.

B. Assemblies shall be provided with vent and drain holes as required by the fabricator. Vent and drain hole sizes and locations shall be included in the structural steel shop drawings required in Specification 05120 Structural Steel for approval. All vent and drain holes shall be plugged and finished to be flush with and blend in with the surrounding surface. Where water intrusion can occur, the plug shall be carefully melted into the surrounding zinc coating using an appropriate fluxing agent.

3.04 METAL DECK

A. Unless noted otherwise, metal deck shall be galvanized in accordance with ASTM A653 G60 minimum. In moist environments or as indicated on the Contract Drawings, galvanizing shall meet the requirements of ASTM A653 G90.

B. Galvanized metal deck shall meet the requirements of ASTM A924.

3.05 REPAIR OF GALVANIZING

A. Galvanized surfaces that are abraded or damaged at any time after the application of zinc coating shall be repaired by thoroughly wire brushing the damaged areas and removing all loose and cracked coating, after which the cleaned areas shall be painted with 2 coats of zinc rich paint meeting the requirements of Federal Specification DOD-P-21035A and shall be thoroughly mixed prior to application. Zinc rich paint shall not be tinted. The total thickness of the 2 coats shall not be less than 6 mils. In lieu of repairing by painting with zinc rich paint, other methods of repairing galvanized surfaces in accordance with ASTM A780 may be used provided the proposed method is acceptable to the Engineer.

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SECTION 05050

METAL FASTENING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all metal welds and fasteners not otherwise specified, in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05010 - Metal Materials

B. Section 05035 - Galvanizing

C. Section 05061 – Stainless Steel

D. Section 05120 - Structural Steel

E. Section 05140 - Structural Aluminum

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Building Code 6th Edition (2017)

2. AC 193 — Acceptance Criteria for Mechanical Anchors in Concrete Elements

3. AC 308 — Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements

4. ACI 318 — Building Code Requirements for Structural Concrete

5. ACI 355.2 — Qualifications of Post-Installed Mechanical Anchors in Concrete

6. ACI 355.4 — Qualifications of Post-Installed Adhesive Anchors in Concrete

7.	AISC 348	The 2009 RCSC Specification for Structural Joints
8.	AISC	Code of Standard Practice
9.	AWS D1.1	Structural Welding Code - Steel
10.	AWS D1.2	Structural Welding Code - Aluminum
11.	AWS D1.6	Structural Welding Code – Stainless Steel
12.	Aluminum Association	Specifications for Aluminum Structures
13.	ASTM A572/A572M-94C	Standard Specification for High Strength Low-Alloy Columbium-Vanadium Structural Steel Grade 50
14.	ASTM A36	Standard Specification for Carbon Structural Steel
15.	ASTM A325	Standard Specification for High-Strength Bolts for Structural Steel Joints
16.	ASTM A489	Standard Specification for Eyebolts
17.	ASTM A490	Standard Specification for Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints
18.	ASTM A563	Standard Specifications for Carbon and Alloy Steel Nuts
19.	ASTM D1785	Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe
20.	ASTM E488	Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
21.	ASTM F436	Standard Specification for Hardened Steel Washers
22.	ASTM F467	Standard Specification for Nonferrous Nuts for General Use
23.	ASTM F593	Standard Specification for Stainless Steel Bolts; Hex Cap Screws, and Studs
24.	ASTM F594	Standard Specification for Stainless Steel Nuts
25.	ASTM F1554	Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01300, Submittals.

1. Shop Drawings providing the fastener's manufacturer and type and certification of the fastener's material and capacity.

2. Anchor design calculations sealed by a Professional Engineer currently registered in the State of Florida. Only required if design not shown on Contract Drawings.

3. Manufacturer’s installation instructions.

4. Copy of valid certification for each person who is to perform field welding.

5. Certified weld inspection reports, when required.

6. Welding procedures.

7. Installer qualifications.

8. Certification of Installer Training.

9. Inspection Reports.

10. Results of Anchor Proof Testing.

1.05 QUALITY ASSURANCE

A. Fasteners not manufactured in the United States shall be tested and certification provided with respect to specified quality and strength standards. Certifications of origin shall be submitted for all U.S. fasteners supplied on the project.

B. Installer Qualifications: All concrete anchors shall be installed by an Installer with at least three years of experience performing similar installations. Concrete adhesive anchor installer shall be certified as an Adhesive Anchor Installer in accordance with ACI-CRSI Adhesive Anchor Installation Certification Program.

C. Installer Training: For concrete adhesive anchors, conduct a thorough training with the manufacturer or the manufacturer’s representative for the Installer on the project. Training shall consist of a review of the complete installation process to include but not be limited to the following:

1. Hole drilling procedure.

2. Hole preparation and cleaning technique.

3. Adhesive injection technique and dispenser training/maintenance.

4. Concrete adhesive anchor preparation and installation.

5. Proof loading/torquing.

D. All steel welding shall be performed by welders certified in accordance with AWS D1.1. All aluminum welding shall be performed by welders certified in accordance with AWS D1.2. All stainless steel welding shall be performed by welders certified in accordance with AWS D1.6. Certifications of field welders shall be submitted prior to performing any field welds.

E. Welds and high strength bolts used in connections of structural steel will be visually inspected in accordance with Article 3.04.

F. The Owner may engage an independent testing agency to perform testing of welded connections and to prepare test reports in accordance with AWS. Inadequate welds shall be corrected or redone and retested to the satisfaction of the Engineer and/or an acceptable independent testing laboratory, at no additional cost to the Owner.

G. Provide a welding procedure for each type and thickness of weld. For welds that are not prequalified, include a Performance Qualification Report. The welding procedure shall be given to each welder performing the weld. The welding procedure shall follow the format in Annex E of AWS D1.1 with relevant information presented.

H. Inspections of the adhesive dowel system shall be made by the Engineer or other representatives of the Owner in accordance with the requirements of the ESR published by the manufacturer. Provide adequate time and access for inspections of products and anchor holes prior to injections, installation, and proof testing.

PART 2 -- PRODUCTS

2.01 ANCHOR RODS (ANCHOR BOLTS)

A. Anchor rods shall conform to ASTM F1554 Grade 36 except where stainless steel or other approved anchor rods are shown on the Drawings. Anchor rods shall have hexagonal heads and shall be supplied with hexagonal nuts meeting the requirements of ASTM A563 Grade A.

B. Where anchor rods are used to anchor galvanized steel or are otherwise specified to be galvanized, anchor rods and nuts shall be hot-dip galvanized in accordance with ASTM F1554.

C. Where pipe sleeves around anchor rods are shown on the Drawings, pipe sleeves shall be cut from Schedule 40 PVC plastic piping meeting the requirements of ASTM D1785.

2.02 HIGH STRENGTH BOLTS

A. High strength bolts and associated nuts and washers shall be in accordance with ASTM A325 or ASTM A490. Bolts, nuts and washers shall meet the requirements of AISC 348 "The 2009 RCSC Specification for Structural Joints”.

B. Where high strength bolts are used to connect galvanized steel or are otherwise specified to be galvanized, bolts, nuts, and washers shall be hot-dip galvanized in accordance with ASTM A325.

2.03 STAINLESS STEEL BOLTS

A. Stainless steel bolts shall conform to ASTM F-593. All underwater fasteners, fasteners in confined areas containing fluid, and fasteners in corrosive environments shall be Type 316 stainless steel unless noted otherwise. Fasteners for aluminum and stainless steel members not subject to the above conditions shall be Type 304 stainless steel unless otherwise noted.

B. Stainless steel bolts shall have hexagonal heads with a raised letter or symbol on the bolts indicating the manufacturer, and shall be supplied with hexagonal nuts meeting the requirements of ASTM F594. Nuts shall be of the same alloy as the bolts.

2.04 CONCRETE ANCHORS

A. General

1. Where concrete anchors are called for on the Drawings, one of the types listed below shall be used; except, where one of the types listed below is specifically called for on the Drawings, only that type shall be used. The determination of anchors equivalent to those listed below shall be on the basis of test data performed by an approved independent testing laboratory. There are two types used:

   a. Expansion anchors shall be mechanical anchors of the wedge, sleeve, drop-in or undercut type.

   b. Adhesive anchors shall consist of threaded rods or bolts anchored with an adhesive system into hardened concrete. Adhesive anchors shall be two part injection type using the manufacturer's static mixing nozzle and shall be supplied as an entire system.

2. Expansion anchors shall not be used to hang items from above or in any other situations where direct tension forces are induced in anchor.

3. Unless otherwise noted, all concrete anchors which are submerged or are used in hanging items or have direct tension induced upon them, or which are subject to vibration from equipment such as pumps and generators, shall be adhesive anchors.

4. Adhesive anchors shall conform to the requirements of ACI 355.4 or alternately to AC 308. Expansion or mechanical anchors shall conform to the requirements of ACI 355.2 or alternately to AC 193. Anchors in Seismic Design Categories C through F shall conform to the International Building Code and ACI 318 Appendix D requirements as applicable, including seismic test requirements.

5. Fire Resistance: All anchors installed within fire resistant construction shall either be enclosed in a fire resistant envelope, be protected by approved fire-resistive materials, be used to resist wind and earthquake loads only, or anchor non-structural elements.

6. Engineer's approval is required for use of concrete anchors in locations other than those shown on the Drawings.

B. Concrete Anchor Design:

An anchor design consists of specifying anchor size, quantity, spacing, edge distance and embedment to resist all applicable loads. Where an anchor design is indicated on the Drawings, it shall be considered an engineered design and anchors shall be installed to the prescribed size, spacing, embedment depth and edge distance. If all parts of an anchor design are provided on the Drawings except embedment depth, the anchors will be considered an engineered design and the Contractor shall provide the embedment depth as indicated in Paragraph B.3 unless otherwise directed by the Engineer. Where an anchor design is not indicated by the Engineer on the Drawings, the Contractor shall provide the anchor design per the requirements listed below.

1. Structural Anchors: All concrete anchors shall be considered structural anchors if they transmit load between structural elements; transmit load between non-structural components that make up a portion of the structure and structural elements; or transmit load between life-safety related attachments and structural elements. Examples of structural concrete anchors include but are not limited to column anchor bolts, anchors supporting non-structural walls, sprinkler piping support anchors, anchors supporting heavy, suspended piping or equipment, anchors supporting barrier rails, etc. For structural anchors, the Contractor shall submit an engineered design with signed and sealed calculations performed by an Engineer currently registered in the State of Florida. Structural anchors shall be of a type recommended by the anchor manufacturer for use in cracked concrete and shall be designed by the Contractor in accordance with ACI 318 Appendix D.

2. Non-Structural Anchors: All other concrete anchors may be considered non-structural concrete anchors. The Contractor shall perform an engineered design for non-structural anchors. The Engineer may request the Contractor provide anchor design details for review, but submission of a signed, sealed design is not required. Non-structural anchors shall be designed by the contractor for use in uncracked concrete.

3. Embedment Depth

   a. Minimum anchor embedment shall be as indicated on the Drawings or determined by the Contractor's engineered design. Although all manufacturers listed are permitted, the embedment depth indicated on the Drawings is based on "Pure 110+ by DeWALT" ESR 3298 issued 7/2016. If the contractor submits one of the other concrete adhesive

anchors listed, the Engineer shall evaluate the required embedment and the Contractor shall provide the required embedment depth stipulated by the Engineer specific to the approved dowel adhesive.

b. Where the embedment depth is not shown on the Drawings, concrete anchors shall be embedded no less than the manufacturer's standard embedment (expansion or mechanical anchors) or to provide a minimum allowable bond strength equal to the allowable yield capacity of the rod according to the manufacturer (adhesive anchors).

c. The embedment depth shall be determined using the actual concrete compressive strength, a cracked concrete state, maximum long term temperature of 110 degrees F, and maximum short term temperature of 140 degrees F. In no case shall the embedment depth be less than the minimum or more than the maximum stated in the manufacturer's literature.

C. Structural Anchors:

1. Mechanical Anchors:

a. Wedge Anchors: Wedge anchors shall be "Kwik Bolt TZ" by Hilti, Inc., "TruBolt +" by ITW Redhead, "Strong-Bolt 2" by Simpson Strong-Tie Co. or "Power-Stud + SD-1" or "Power-Stud + SD-2" by DeWALT.

b. Screw Anchors: Screw anchors shall be "Kwik HUS-EZ" and "KWIK HUS-EZ-I" by Hilti, Inc., "Titen HD" by Simpson Strong-Tie Co., or "Wedge-Bolt +" by DeWALT. Bits specifically provided by manufacturer of chosen system shall be used for installation of anchors.

c. Sleeve Anchors: Sleeve anchors shall be "HSL-3 Heavy Duty Sleeve Anchor" by Hilti, Inc. or "Power-Bolt +" by DeWALT.

d. Undercut Anchors: Undercut anchors shall be "HDA Undercut Anchor" by Hilti, Inc., "Torq-Cut Undercut Anchor" by Simpson Strong-Tie Co., "Atomic + Undercut Anchor" by DeWALT.

2. Adhesive Anchors:

a. Adhesive anchors shall be "Epcon C6+ Adhesive Anchoring System" by ITW Redhead, "HIT HY-200 Adhesive Anchoring System" by Hilti, Inc., "SET-XP Epoxy Adhesive Anchors" by Simpson Strong-Tie Co., or "Pure 110+ Epoxy Adhesive Anchor System" by DeWALT.

b. Structural adhesive anchor systems shall be IBC compliant and capable of resisting short term wind and seismic loads (Seismic Design Categories A through F) as well as long term and short term sustained static loads in both cracked and uncracked concrete in all Seismic Design

Categories. Structural adhesive anchor systems shall comply with the latest revision of ICC-ES Acceptance Criteria AC308, and shall have a valid ICC-ES report in accordance with the applicable building code. **No "or equal" products will be considered unless prequalified and approved by the Engineer and Owner.**

D. Non-Structural Anchors: In addition to the acceptable non-structural anchors listed below, all structural anchors listed above may also be used as non-structural anchors.

1. Mechanical Anchors:

a. Wedge Anchors: Wedge anchors shall be "Kwik Bolt 3" by Hilti, Inc., "Wedge-All" by Simpson Strong-Tie Co. or "TruBolt" by ITW Redhead.

b. Screw Anchors: Screw anchors shall be "Kwik HUS" by Hilti, Inc., "Screw Bolt +" or 316 Stainless Steel Wedge-Bolt" by DeWALT, "Large Diameter Tapcon (LDT) Anchor" by ITW Redhead, or "Titen HD" by Simpson Strong-Tie Co. Bits specifically provided by manufacturer of chosen system shall be used for installation of anchors.

c. Sleeve Anchors: Sleeve anchors shall be "HSL Heavy Duty Sleeve Anchors" by Hilti, Inc. "Power-Bolt +" by DeWALT, "Dynabolt Sleeve Anchor" by ITW Redhead, or "Sleeve-All" by Simpson Strong-Tie Co.

d. Drop-In Anchors: Drop-in anchors shall be "Drop-In" by Simpson Strong-Tie Co., "HDI Drop-In Anchor" by Hilti, Inc. or "Multi-Set II Drop-In Anchor" by ITW Redhead.

e. Undercut Anchors: Undercut anchors shall be "HDA Undercut Anchor" by Hilti, Inc., or "Torq-Cut" by Simpson Strong-Tie Co.

2. Adhesive Anchors:

a. Adhesive anchors shall be "Epcon A7" or "Epcon C6+ Adhesive Anchoring System" by ITW Redhead, "HIT HY-200 Adhesive Anchoring System" by Hilti, Inc., "SET Epoxy Tie High Strength Anchoring Adhesive" or "AT High Strength Anchoring Adhesive" by Simpson Strong-Tie Co., or "AC 100+ Gold" by DeWALT.

b. Non-structural adhesive anchors systems shall be IBC compliant and capable of resisting short term wind and seismic (Seismic Design Categories A and B) as well as long term and short term sustained static loads in uncracked concrete.

c. Non-structural adhesive anchor embedment depth of the rod shall provide a minimum allowable bond strength that is equal to the allowable yield capacity of the rod unless noted otherwise on the Drawings.

d. **No “or equal” products will be considered unless prequalified and approved by the Engineer and Owner.**

E. Concrete Anchor Rod Materials:

1. Concrete anchors used to anchor structural steel shall be a threaded steel rod per manufacturer’s recommendations for proposed adhesive system, but shall not have a yield strength (fy) less than 58 ksi nor an ultimate strength (fu) less than 72.5 ksi, unless noted otherwise. Where steel to be anchored is galvanized, concrete anchors shall also be galvanized unless otherwise indicated on the Drawings.

2. Concrete anchors used to anchor aluminum, FRP, or stainless steel shall be Type 304 stainless steel unless noted otherwise. All underwater concrete anchors shall be Type 316 stainless steel.

3. Nuts, washers, and other hardware shall be of a material to match the anchors.

2.05 MASONRY ANCHORS

A. Anchors for fastening to solid or grout-filled masonry shall be adhesive anchors as specified above for concrete anchors.

B. Anchors for fastening to hollow masonry or brick shall be adhesive anchors consisting of threaded rods or bolts anchored with an adhesive system dispensed into a screen tube inserted into the masonry. The adhesive system shall use a two-component adhesive mix and shall inject into the screen tube with a static mixing nozzle. Thoroughly clean drill holes of all debris and drill dust prior to installation of adhesive and anchor. Contractor shall follow manufacturer’s installation instructions. The adhesive system shall be “HIT HY-70 System” as manufactured by Hilti, Inc., or “SET-XP” as manufactured by Simpson Strong-Tie Co.

C. Masonry anchors used to anchor steel shall be a threaded steel rod per manufacturer’s recommendations for proposed adhesive system, but shall not have a yield strength (fy) less than 58 ksi nor an ultimate strength (fu) less than 72.5 ksi, unless noted otherwise. Where steel to be anchored is galvanized, masonry anchors shall also be galvanized.

D. Masonry anchors used to anchor aluminum, FRP, or stainless steel shall be Type 304 stainless steel unless noted otherwise. All underwater anchors shall be Type 316 stainless steel.

E. Although all manufacturers listed are permitted, the masonry anchor design is based on “SET-XP” by Simpson Strong-Tie ER 265 Revised 1-31-2017. If the contractor submits one of the other concrete adhesive anchors listed, the Engineer shall evaluate the proposed product and the Contractor shall provide the conditions stipulated by the Engineer specific to the approved adhesive anchor.

2.06 WELDS

A. Electrodes for welding structural steel and all ferrous steel shall comply with AWS Code, using E70 series electrodes for shielded metal arc welding (SMAW), or F7 series electrodes for submerged arc welding (SAW).

B. Electrodes for welding aluminum shall comply with the Aluminum Association Specifications and AWS D1.2.

C. Electrodes for welding stainless steel and other metals shall comply with AWS D1.6.

2.07 WELDED STUD CONNECTORS

A. Welded stud connectors shall conform to the requirements of AWS D1.1 Type C.

2.08 EYEBOLTS

A. Eyebolts shall conform to ASTM A489 unless noted otherwise.

2.09 HASTELLOY FASTENERS

A. Hastelloy fasteners and nuts shall be constructed of Hastelloy C-276.

2.10 ANTISEIZE LUBRICANT

A. Antiseize lubricant shall be C5-A Anti-Seize by Loctite Corporation, Molykote P-37 Anti-Seize Paste by Dow Corning, 3M Anti-Seize by 3M, or equal.

PART 3 -- EXECUTION

3.01 MEASUREMENTS

A. The Contractor shall verify all dimensions and review the Drawings and shall report any discrepancies to the Engineer for clarification prior to starting fabrication.

3.02 ANCHOR INSTALLATION

A. Anchor Rods, Concrete Anchors, and Masonry Anchors

1. Anchor rods shall be installed in accordance with AISC "Code of Standard Practice" by setting in concrete while it is being placed and positioned by means of a rigidly held template. Overhead adhesive anchors, and base plates or elements they are anchoring, shall be shored as required and securely held in place during anchor setting to prevent movement during anchor installation. Movement of anchors during curing is prohibited.

2. The Contractor shall verify that all concrete and masonry anchors have been installed in accordance with the manufacturer's recommendations and that the capacity of the installed anchor meets or exceeds the specified safe holding capacity.

3. Concrete anchors shall not be used in place of anchor rods without Engineer's approval.

4. All stainless steel threads shall be coated with antiseize lubricant.

B. High Strength Bolts

1. All bolted connections for structural steel shall use high strength bolts. High strength bolts shall be installed in accordance with AISC 348 "The 2009 RCSC Specification for Structural Joints". All bolted joints shall be Type N, snug-tight, bearing connections in accordance with AISC Specifications unless noted otherwise on the Drawings.

C. Concrete Anchors

1. Concrete at time of anchor installation shall be a minimum age of 21 days, have a minimum compressive strength of 2500 psi, and shall be at least 50 degrees F.

2. Concrete anchors designed by the Contractor shall be classified as structural or non-structural based on the requirements indicated above.

3. Concrete Anchor Testing:

a. At all locations where concrete anchors meet the requirements for structural anchors at least 25 percent of all concrete anchors installed shall be proof tested to the value indicated on the Drawings, with a minimum of one tested anchor per anchor group. If no test value is indicated on the Drawings but the installed anchor meets the requirements for structural anchors, the Contractor shall notify the Engineer to allow verification of whether anchor load proof testing is required.

b. Contractor shall submit a plan and schedule indicating locations of anchors to be proof tested, load test values and proposed anchor testing procedure (including a diagram of the testing equipment proposed for use) to the Engineer for review prior to conducting any testing. Proof testing of anchors shall be in accordance with ASTM E488 for the static tension test. If additional tests are required, inclusion of these tests shall be as stipulated on Contract Drawings.

c. Where Contract Documents indicate anchorage design to be the Contractor's responsibility and the anchors are considered structural per the above criteria, the Contractor shall submit a plan and schedule indicating locations of anchors to be proof tested and load test values, sealed by a Professional Engineer currently registered in the State of Florida. The Contractor's Engineer shall also submit documentation indicating the Contractor's proof testing procedures have been reviewed

and the proposed procedures are acceptable. Proof testing procedures shall be in accordance with ASTM E488.

d. Concrete Anchors shall have no visible indications of displacement or damage during or after the proof test. Concrete cracking in the vicinity of the anchor after loading shall be considered a failure. Anchors exhibiting damage shall be removed and replaced. If more than 5 percent of tested anchors fail, then 100 percent of anchors shall be proof tested.

e. Proof testing of concrete anchors shall be performed by an independent testing laboratory hired directly by the Contractor and approved by the Engineer. The Contractor shall be responsible for costs of all proof testing, including additional testing required due to previously failed tests.

4. All concrete anchors shall be installed in strict conformance with the manufacturer's printed installation instructions. A representative of the manufacturer shall be on site when required by the Engineer.

5. All holes shall be drilled in accordance with the manufacturer's instructions except that cored holes shall not be allowed unless specifically approved by the Engineer. If cored holes are allowed by the manufacturer and approved by the Engineer, cored holes shall be roughened in accordance with manufacturer requirements. Thoroughly clean drill holes of all debris, drill dust, and water in accordance with the manufacturer's instructions prior to installation of adhesive and threaded rod unless otherwise recommended by the manufacturer. Degree of hole dampness shall be in strict accordance with manufacturer recommendations. Installation conditions shall be either dry or water-saturated. Water filled or submerged holes shall not be permitted unless specifically approved by the Engineer. Injection of adhesive into the hole shall be performed to minimize the formation of air pockets in accordance with the manufacturer's instructions. Wipe rod free from oil that may be present from shipping or handling.

D. Other Bolts

1. All dissimilar metal shall be connected with appropriate fasteners and shall be insulated with a dielectric or approved equal.

2. All stainless steel bolts shall be coated with antiseize lubricant.

3.03 WELDING

A. All welding shall comply with AWS Code for procedures, appearance, quality of welds, qualifications of welders and methods used in correcting welded work.

B. Welded stud connectors shall be installed in accordance with AWS D1.1.

3.04 INSPECTION

A. High strength bolting will be visually inspected in accordance with AISC 348 "The 2009 RCSC Specification for Structural Joints". Rejected bolts shall be either replaced or retightened as required.

B. Field welds will be visually inspected in accordance with AWS Codes. Inadequate welds shall be corrected or redone as required in accordance with AWS Codes.

C. Post-installed concrete anchors shall be inspected as required by ACI 318.

3.05 CUTTING OF EMBEDDED REBAR

A. The Contractor shall not cut embedded rebar cast into structural concrete during installation of post-installed fasteners without prior approval of the Engineer.

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SECTION 05061

STAINLESS STEEL

PART 1 -- GENERAL

1.01 SECTION INCLUDES

A. The Contractor shall furnish, install and erect the stainless steel work as shown on the Contract Drawings and specified herein.

B. Stainless steel work shall be furnished complete with all accessories, mountings and appurtenances of the type of stainless steel and finish as specified or required for a satisfactory installation.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 - Submittals

B. Section 05010 - Metal Materials

C. Section 05050 - Metal Fastening

D. Section 05500 - Metal Fabrications

1.03 REFERENCES

A. ASTM A193 - Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.

B. ASTM A194 - Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.

C. ASTM A262 - Practice for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steel.

D. ASTM A276 - Stainless and Heat-Resisting Steel Bars and Shapes.

E. ASTM A314 - Stainless and Heat-Resisting Steel Billets and Bars for Forging.

F. ASTM A380 - Practice for Cleaning and Descaling Stainless Steel Parts, Equipment and Systems.

G. ASTM A473 - Stainless and Heat-Resisting Steel Forgings.

H. ASTM A666 - Austenitic Stainless Steel, Sheet, Strip, Plate and Flat Bar.

I. ASTM A774 - Stainless Steel Pipe Fittings

J. ASTM A778 - Stainless Steel Pipe

K. ASTM F593 - Stainless Steel Bolts, Hex Cap Screws and Studs.

L. ASTM F594 - Stainless Steel Nuts.

M. ANSI/ASME B1.1 - Unified Inch Screw Thread (UN and UNR Thread Form).

1.04 TESTS

A. All stainless steel materials including stainless test welds, shall be checked for compliance with tests for susceptibility to intergranular attack. Such tests shall be Practices A, B and E of ASTM A262. Detailed procedures for the tests shall be submitted to the Engineer for approval prior to start of work. Practice A shall be used only for acceptance of materials but not for rejection of materials, and shall be used for screening material intended for testing in Practice B and Practice E. The maximum acceptable corrosion rate under Practice B shall be 0.004 inch per month, rounded off to the third decimal place. If the certified mill report indicates that such test has been satisfactory performed, the fabricator may not be required to repeat the test. Material passing Practice E shall be acceptable.

B. Sample selection for the susceptibility to intergranular attack tests shall be as follows:

1. One (1) sample per heat treatment lot for plates and forgings;

2. One (1) sample per each Welding Procedure Qualification regardless of the joint design;

3. If tests indicate a reduction in corrosion resistance, welding procedure shall be adjusted or heat treatment determined as needed to restore required corrosion resistance.

4. The samples so chosen shall have received all the post-weld heat treatments identical to the finished part.

1.05 SUBMITTALS

A. The Contractor shall prepare and submit for approval shop drawings for all stainless steel fabrication in accordance with Section 01300, Submittals.

B. Submittals shall include, but not be limited to, the following:

1. Certified test reports for susceptibility to intergranular attack.

2. Affidavit of compliance with type of stainless steel shown on the Contract Drawings or specified herein.

3. Certified weld inspection reports.

4. Cleaning and handling of stainless steel in accordance with Paragraph 3.04, Cleaning and Handling.

C. Samples of finish, on each type of stainless steel to be furnished, shall be submitted to the Engineer upon request.

1.06 QUALITY ASSURANCE

A. Shop inspections may be made by the Engineer. The Contractor shall give ample notice to the Engineer prior to the beginning of any stainless steel fabrication work so that inspection may be provided. The Contractor shall furnish all facilities for the inspection of materials and workmanship in the shop, and the inspectors shall be allowed free access to the necessary parts of the works.

B. Inspectors shall have the authority to reject any materials or work which does not meet the requirements of the Contract Drawings or the Specifications.

C. Inspection at the shop is intended as a means of facilitating the work and avoiding errors, but is expressly understood that it will in no way relieve the Contractor from his responsibility for furnishing proper materials or workmanship.

1.07 HANDLING, STORAGE AND DELIVERY

A. Mechanical damage (e.g., scratches and gouges) to the stainless steel material shall not be permitted and is cause for rejection. Care shall be taken in the material handling since such mechanical damage will result in the passive oxide film being "punctured" leading to a possible lower resistance to the initiation of corrosion than the surrounding chemically-passivated surface.

B. Stainless steel plates and sheets shall be stored vertically in racks and not be dragged out of the racks or over one another. Racks shall be protected to prevent iron contamination.

C. Heavy stainless steel plates shall be carefully separated and chocked with wooden blocks so that the forks of a fork-lift could be inserted between plates without mechanically damaging the surface.

D. Stainless steel plates and sheets laid out for use shall be off the floor and be divided by wooden planks to prevent surface damage and to facilitate subsequent handling.

E. Plate clamps, if used, shall be used with care as the serrated faces can dig in, indent and gouge the surface.

F. Stainless steel fabrications shall be loaded in such a manner that they may be transported and unloaded without being overstressed, deformed or otherwise damaged.

G. Stainless steel fabrications and packaged materials shall be protected from corrosion and deterioration and shall be stored in a dry area. Materials stored outdoors shall be supported above ground surfaces on wood runners and protected with approved effective and durable covers.

H. Stainless steel fabrications shall not be placed in or on a structure in a manner that might cause distortion or damage to the fabrication. The Contractor shall repair or replace damaged stainless steel fabrications or materials as directed by the Engineer.

1.08 FIELD MEASUREMENTS

A. The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of the work.

B. The Contractor shall review the Contract Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

PART 2 -- PRODUCTS

2.01 MATERIALS AND FINISHES

A. Stainless steel shall be Type 304 unless it is used for underwater service. Stainless steel for underwater service shall be Type 316. Minimum mechanical finish shall be No. 4 as stated in Table 2 unless otherwise noted on the Contract Drawings.

B. The basic mill forms (sheet, strip, plate and bar) are classified by size as shown on Table 1. Tables 2, 3 and 4 identify finishes and conditions in which sheet, bar and plate are available.

C. Tables 2, 3 and 4 show numbered finishes and conditions for sheet, bar and plate. While there are no specific designations for polished finishes on bar or plate, the sheet finish designations are used to describe the desired effect. This also applies to finishes on ornamental tubing.

D. There are three standard finishes for strip, which are broadly described by the finishing operations employed:

1. No. 1 Strip Finish

   No. 1 strip finish is approximately the same as No. 2D Sheet Finish. It varies in appearance from dull gray matte to a fairly reflective surface, depending largely on alloy composition and amount of cold reduction.

2. No. 2 Strip Finish is approximately the same as a No. 2B sheet finish. It is smoother, more reflective than No. 1, and likewise varies with alloy composition.

3. Bright annealed finish is a highly reflective finish that is retained by final annealing in a controlled atmosphere furnace.

Table 1

Classification of Stainless Steel Product Form

Item	Description	Dimensions		
		Thickness	Width	Diameter or Size
Sheet	Coils and cut length: Mill finishes Nos. 1, 2D and 2B Polished finishes Nos. 3, 4, 6, 7 & 8	 under 3/16" under 3/16"	 24" and over all widths	 -- --
Strip	Cold finished, coils or cut lengths Polished finishes Nos. 3, 4, 6,7 & 8	under 3/16" under 3/16"	under 24" all widths	-- --
Plate	Flat rolled or forged	3/16" and over	over 10"	--
Bar	Hot finished rounds, squares, octagons and hexagons Hot finished flats Cold finished rounds, squares, octagons and hexagons Cold finished flats	-- 1/8" to 8" incl. -- 1/8" to 4-1/2"	-- 1/4" to 10" incl. -- 3/8" to 4-1/2"	1/4" and over -- over 1/8" --
Wire	Cold finishes only: (in coil) Round, square, octagon, hexagon and flat wire	 under 3/16"	 under 3/8"	 --
Pipe & Tubing	Several different classifications, with differing specifications, are available.			
Extrusion	Not considered “standard” shapes. Currently limited in size to approximately 6-1/2" diameter or structurals.			

Table 2

Standard Mechanical Sheet Finishes

Unpolished or Rolled Finishes: No. 1 A rough dull surface which results from hot rolling to the specified thickness followed by annealing and descaling.	No. 4 A polished surface obtained by finishing with a 120-150 mesh abrasive, following initial grinding with coarser abrasives. This is a general purpose bright finish with a visible "grain" which prevents mirror reflection.
No. 2D A dull finish which results from cold rolling followed by annealing and descaling, and may perhaps get a final light roll pass through unpolished rolls. A 2D finish is used where appearance is of no concern.	No. 6 A dull satin finish having lower reflectivity than No. 4 finish. It is produced by Tampico brushing the No. 4 finish in a medium of abrasive and oil. It is used for architectural applications and ornamentation where a high luster is undesirable, and to contrast with brighter finishes.
No. 2B A bright cold-rolled finish resulting in the same manner as No. 2D finish, except that the annealed and descaled sheet receives a final light roll pass through polished rolls. This is the general purpose cold-rolled finish that can be used as is, or as a preliminary step to polishing.	No. 7 A high reflective finish that is obtained by buffing finely ground surfaces but not to the extent of completely removing the "grit" lines. It is used chiefly for architectural and ornamental purposes.
Polished Finishes: No. 3 An intermediate polish surface obtained by finishing with a 100 grit abrasive. Generally used where a semi-finished polished surface is required. A No. 3 finish usually receives additional polishing during fabrication.	No. 8 The most reflective surface, which is obtained by polishing with successively finer abrasives and buffing extensively until all grit lines from preliminary grinding operations are removed. It is used for applications such as mirrors and reflectors.

Table 3

Conditions and Finishes for Bar

Conditions	Surface Finishes[1]
Hot worked only	(a) Scale not removed (excluding spot conditioning) (b) Rough turned[2] (c) Pickled or blast cleaned and pickled.
Annealed or otherwise heat treated.	(a) Scale not removed (excluding spot conditioning) (b) Rough turned (c) Pickled or blast cleaned and pickled (d) Cold drawn or cold rolled (e) Centerless ground (f) Polished
Annealed and cold worked to high tensile strength[3]	(d) Cold drawn or cold rolled (e) Centerless ground (f) Polished

1 Surface finishes (b), (e) and (f) are applicable to round bars only.

2 Bars of the 4xx series stainless steels which are highly hardenable, such as Types 414, 420, 420F, 431, 440A, 440B and 440C, are annealed before rough turning. Other hardenable grades, such as Types 403, 410, 416 and 416Se, may also require annealing depending on their composition and size.

3 Produced in Types 302, 303Se, 304 and 316.

Table 4

Conditions and Finishes for Plate

Condition and Finish	Description and Remarks
Hot rolled	Scale not removed. Not heat treated. Plates not recommended for final use in this condition.[4]
Hot rolled, annealed or heat treated	Scale not removed. Use of plates in this condition is generally confined to heat resisting applications. Scale impairs corrosion resistance.[1]
Hot rolled, annealed or heat treated, blast cleaned or pickled	Condition and finish commonly preferred for corrosion resisting and most heat resisting applications.
Hot rolled, annealed, descaled and temper passed	Smoother finish for specialized applications.
Hot rolled, annealed, descaled cold rolled, annealed, descaled, optionally temper passed	Smooth finish with greater freedom from surface imperfection than the above.
Hot rolled, annealed or heat treated, surface cleaned and polished	Polished finishes refer to Table 2.

[4] Surface inspection is not practicable on plates which have not been pickled or otherwise descaled.

PART 3 -- EXECUTION

3.01 FABRICATION

A. Holes for bolts and screws shall be drilled. Fastenings shall be concealed where practicable. Joints exposed to the weather shall be formed to exclude water.

B. As far as practicable, all fabricated units shall be fitted and assembled in the shop, with all cuts and bends made to precision measurements in accordance with details shown on approved shop drawings.

C. Work shall be fabricated so that it is installed in a manner that will provide for expansion and contraction, prevent the shearing of bolts, screws and other fastenings, ensure rigidity, and provide close fitting of sections.

D. All finished and/or machined faces shall be true to line and level. Stainless steel sections shall be well formed to shape and size with sharp lines and angles; curved work shall be sprung evenly to curves.

E. All work shall be fitted together at the shop as far as possible, and delivered complete and ready for erection. Proper care shall be exercised in handling all work so as not to injure the finished surfaces.

3.02 WELDING

A. Welding shall be done in a manner that will prevent buckling and in accordance with Specification 05050 – Metal Fastening, and as modified hereinafter.

B. All welds exposed in the work shall be ground smooth and finished to match the finish of the adjacent stainless steel surfaces.

C. Select weld rods that provide weld filler metal having corrosion resistant properties as nearly identical or better than the base metal to insure preservation of the corrosion-resistant properties. Provide heat treatment at welds where testing of weld procedure indicates it is required to restore the corrosion resistance.

D. Thermal conductivity of stainless steel is about half that of other steels; and the following methods may be used to accommodate this situation:

1. Use lower weld current setting.

2. Use skip-weld techniques to minimize heat concentration.

3. Use back-up chill bars or other cooling techniques to dissipate heat.

E. Edges of the stainless steel to be welded shall be cleaned of contaminants.

3.03 FASTENERS

A. Stainless steel fasteners shall be used for joining stainless steel work.

B. Stainless steel fasteners shall be made of alloys that are equal to or more corrosion resistant than the materials they join.

3.04 CLEANING AND HANDLING

A. All stainless steel surfaces shall be precleaned, descaled, passivated and inspected before, during and after fabrication in accordance with the applicable sections of ASTM A380 and as detailed in the procedures to be submitted to the Engineer for approval prior to start of work. Degreasing and passivation of stainless steel articles shall be conducted as the last step after fabrication.

B. Measures to protect cleaned surfaces shall be taken as soon as final cleaning is completed and shall be maintained during all subsequent handling, storage and shipping.

1. The Contractor shall submit for approval specific procedures listing all the steps to be followed in detecting contamination and in descaling, cleaning, passivation and protecting of all stainless steel.

2. Area showing clear indications of contamination shall be recleaned, repassivated and reinspected.

C. At approved stages in the shop operations, contaminants such as scale, embedded iron, rust, dirts, oil, grease and any other foreign matter shall be removed from the metal, as directed or approved by the Engineer. The adequacy of these operations shall be checked by the Engineer. Operations in the shop shall be conducted so as to avoid contamination of the stainless steel and to keep the metal surfaces free from dirt and foreign matter.

D. In order to prevent incipient corrosion during fabrication, special efforts shall be made at all times to keep all stainless steel surfaces from coming in contact with other metals.

1. Stainless steel and stainless steel welds shall be cleaned with clean sand free of iron, stainless steel wool, stainless steel brushes, or other approved means and shall be protected at all times from contamination by any materials, including carbon steel, that shall impair its resistance to corrosion.

2. Approved methods of cutting, grinding and handling shall be used to prevent contamination. If air-arc, or carbon-arc cutting is used, additional metal shall be removed by approved mechanical means so as to provide clean, weldable edges. All grinding of stainless steel shall be performed with aluminum oxide or silicon carbide grinding wheels bonded with resin or rubber. Grinding wheels used on carbon steel shall not be used on stainless steel.

3. Sand, grinding wheels, brushes and other materials used for cleaning stainless steel shall be checked periodically by the Engineer for contaminants. Cleaning aids found to contain contaminants shall not be used on the work.

3.05 INSTALLATION

A. All stainless steel fabrications shall be erected square, plumb and true, accurately fitted, adequately anchored in place, set at proper elevations and positions.

B. All inserts, anchor rods and all other miscellaneous work specified in the Detailed Specifications or shown on the Contract Drawings or required for the proper completion of the work, which are embedded in concrete, shall be properly set and securely held in position in the forms before the concrete is placed.

C. All stainless steel fabrications shall be installed in conformance with details shown on the Contract Drawings or on the approved shop drawings.

-END OF SECTION -

SECTION 05120

STRUCTURAL STEEL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all equipment, labor, materials, and services required to provide all structural steel work in accordance with the Contract Documents. The term "structural steel" shall include items as defined in the AISC "Code of Standard Practice".

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05010 - Metal Materials

B. Section 05035 - Galvanizing

C. Section 05050 - Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents.

1. Florida Building Code 6th Edition (2017)

2. AISC - "Code of Standard Practice."

3. AISC - "Specification for Structural Steel Buildings".

4. AISC 348 - "Specification for Structural Joints Using High-Strength Bolts”.

5. AWS - "Structural Welding Code".

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01300, Submittals.

1. Certified Mill Test Reports

2. Affidavit of Compliance with grade specified

3. Shop Drawings which include the following:

a. Layout drawings indicating all structural shapes, sizes, and dimensions.

b. Beam and column schedules.

c. Detailed drawings indicating jointing, anchoring and connection details and vent and drain holes where required.

4. Structural Steel Survey

1.05 QUALITY ASSURANCE

A. Shop inspection may be required by the Owner at his own expense. The Contractor shall give ample notice to the Engineer prior to the beginning of any fabrication work so that inspection may be provided. The Contractor shall furnish all facilities for the inspection of materials and workmanship in the shop, and the inspectors shall be allowed free access to the necessary parts of the work. Inspectors shall have the authority to reject any materials or work which do not meet the requirements of these Specifications. Inspection at the shop is intended as a means of facilitating the work and avoiding errors, but is expressly understood that it will in no way relieve the Contractor from his responsibility for furnishing proper materials or workmanship under this Specification.

B. The erector shall be a qualified installer who participates in the AISC Certification program and is designated an AISC Certified Erector, Category ACSE.

C. The fabricator shall be a qualified fabricator who participates in the AISC Certification program and is designated an AISC Certified Plant, Category STD**.**

PART 2 -- PRODUCTS

2.01 MATERIALS

A. Structural Steel

1. Structural steel for W shapes shall conform to ASTM A992 unless otherwise indicated.

2. Structural steel for HP shapes shall conform to ASTM A572 Grade 50 unless otherwise indicated.

3. Structural steel for S, M, C, and MC shapes and angles and plates shall conform to ASTM A36 unless otherwise indicated.

4. Steel pipe shall be ASTM A53, Grade B.

5. HSS shall be ASTM A500, Grade C or ASTM A1085. All members shall be furnished full length without splices unless otherwise noted or accepted by the Engineer.

6. All unidentified steel will be rejected and shall be removed from the site and replaced by the Contractor, all at the expense of the Contractor.

7. Fasteners for structural steel shall be in accordance with Section 05050, Metal Fastening.

B. Welds

1. Electrodes for welding shall be in accordance with Section 05050, Metal Fastening.

PART 3 -- EXECUTION

3.01 MEASUREMENT

A. The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of work. The Contractor shall review the Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

3.02 FABRICATION

A. Fabrication shall be in accordance with the AISC "Specification for Structural Steel Buildings and AISC "Code of Standard Practice". Fabrication shall begin only after Shop Drawing approval.

B. Except where otherwise noted on the Drawings or in this Specification, all shop connections shall be welded.

C. All holes in structural steel members required for anchors, anchor rods, bolts, sag rods, vent and drain holes or other members or for attachment of other work shall be provided by the fabricator and detailed on the Shop Drawings.

D. All materials shall be properly worked and match-marked for field assembly.

E. Where galvanizing of structural steel is required, it shall be done in accordance with Section 05035, Galvanizing.

3.03 DELIVERY, STORAGE AND HANDLING

A. Structural members shall be loaded in such a manner that they may be transported and unloaded without being over-stressed, deformed or otherwise damaged.

B. Structural steel members and packaged materials shall be protected from corrosion and deterioration. Material shall be stored in a dry area and shall not be placed in direct contact with the ground. Materials shall not be placed on the structure in a manner that

might cause distortion or damage to the members or the supporting structures. The Contractor shall repair or replace damaged materials or structures as directed.

3.04 ERECTION

A. The erection of all structural steel shall conform to the applicable requirements of the AISC "Specification for Structural Steel Buildings" and AISC "Code of Standard Practice". All temporary bracing, guys and bolts as may be necessary to ensure the safety of the structure until the permanent connections have been made shall be provided by the Contractor.

B. Structural members shall be set accurately to the lines and elevations indicated. The various members shall be aligned and adjusted to form a part of a complete frame or structure before permanently fastened. A licensed land surveyor shall survey the structural steel during erection and shall provide a final survey indicating elevations and locations of all major members. Necessary adjustments to compensate for discrepancies in elevations and alignments shall be performed.

C. No cutting of structural steel members in the field will be allowed except by the written approval of the Engineer.

D. Bearing surfaces and other surfaces which will be in permanent contact shall be cleaned before assembly.

E. Field welding shall not be permitted unless specifically indicated in the Drawings or approved in writing by the Engineer. All field welding shall comply with Section 05050, Metal Fastening.

F. For structures carrying over 5-Ton capacity cranes type “SC” connections are required for roof-truss splices and connections of trusses to columns, columns splices, column bracing, knee braces, and crane supports, AISC J.10 page 16.1-93.

G. All bolted connections shall use high strength bolts in accordance with Section 05050, Metal Fastening. High strength bolts shall be installed in accordance with AISC 348 “The 2009 RCSC Specification for Structural Joints”. Bolts specified or noted on the Drawings to be a tension or slip critical “SC” type connection shall be fully pretensioned with proper preparation of the faying surfaces. All other bolts shall be snug tightened unless otherwise noted on the Drawings.

H. All field connections shall be accurately fitted up before being bolted. Drifting shall be only such as will bring the parts into position and shall not be sufficient to enlarge the holes or to distort the metal. All unfair holes shall be drilled or reamed.

I. Misfits at Bolted Connections

1. Where misfits in erection bolting are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misfit

for review by the Engineer. The Engineer will determine whether the remedy is acceptable or if the member must be refabricated.

2. Incorrectly sized or misaligned holes in members shall not be enlarged by burning or by the use of drift pins. The Contractor shall notify the Engineer immediately and shall submit a proposed method of remedy for review by the Engineer.

3. Where misalignment between anchor rods and rod holes in steel members are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misalignment for review by the Engineer.

J. Grouting of Base Plates and Bearing Plates

1. The bottom surface of the plates shall be cleaned of all foreign materials, and concrete or masonry bearing surface shall be cleaned of all foreign materials and roughened to improve bonding.

2. Accurately set all base and bearing plates to designated levels with steel wedges or leveling plates.

3. Baseplates shall be grouted with non-shrink grout to assure full uniform bearing. Grouting shall be done prior to placing loads on the structure. Non-shrink grout shall conform to Section 03600, Grout.

4. Anchor rods shall be tightened after the supported members have been positioned and plumbed and the non-shrink grout has attained its specified strength.

K. Where finishing is required, assembly shall be completed including bolting and welding of units before start of finishing operations.

3.05 PAINTING

A. Painting shall be performed according to Section 09900, Painting and the following additional requirements.

1. Concrete Encased Steel: Steel members which will be encased in concrete shall be cleaned but not painted prior to encasement.

2. Contact Surfaces: Contact surfaces such as at field connections, shall be cleaned and primed but not painted.

3. Finished Surfaces: Machine finished surfaces shall be protected against corrosion by a rust-inhibiting coating which is easily removed prior to erection or which has characteristics that make removal unnecessary prior to erection.

4. Surfaces Adjacent to Field Welds: Surfaces within 2 inches of any field weld location shall be free of materials that would prevent proper welding or produce objectionable fumes while welding is being done.

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SECTION 05140

STRUCTURAL ALUMINUM

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all equipment, labor, materials, and services required to provide all structural aluminum work in accordance with the Contract Documents. The term "structural aluminum" shall include items as defined in the Aluminum Association "Specifications for Aluminum Structures".

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05010 - Metal Materials

B. Section 05050 - Metal Fastening

C. Section 09900 - Painting

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of other requirements of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of the Bid.

1. Florida Building Code 6th Edition (2017)

2. Aluminum Association "Specifications for Aluminum Structures"

3. AWS D1.2 - "Structural Welding Code".

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01300, Submittals.

1. Certified Mill Test Reports

2. Affidavit of Compliance with grade specified

3. Shop Drawings which include the following:

a. Layout drawings indicating all structural shapes, sizes, and dimensions.

b. Beam and column schedules.

c. Detailed drawings indicating jointing, anchoring and connection details.

1.05 QUALITY ASSURANCE

A. Shop inspection may be required by the Owner at his own expense. The Contractor shall give ample notice to the Engineer prior to the beginning of any fabrication work so that inspection may be provided. The Contractor shall furnish all facilities for the inspection of materials and workmanship in the shop, and the inspectors shall be allowed free access to the necessary parts of the work. Inspectors shall have the authority to reject any materials or work which do not meet the requirements of these Specifications. Inspection at the shop is intended as a means of facilitating the work and avoiding errors, but is expressly understood that it will in no way relieve the Contractor from his responsibility for furnishing proper materials or workmanship under this Specification.

PART 2 -- PRODUCTS

2.01 MATERIALS

A. Structural aluminum shall comply with Section 05010, Metal Materials.

B. Fasteners for structural aluminum shall be in accordance with Section 05050, Metal Fastening.

C. Electrodes for welding shall be in accordance with Section 05050, Metal Fastening.

PART 3 -- EXECUTION

3.01 MEASUREMENT

A. The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of work. The Contractor shall review the Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

3.02 FABRICATION

A. Fabrication shall be in accordance with the Aluminum Association "Specifications for Aluminum Structures". Fabrication shall begin only after Shop Drawing approval.

B. Except where otherwise noted on the Drawings or in this Specification, all shop connections shall be welded.

C. All holes in structural aluminum members required for anchors, anchor rods, bolts, or other members or for attachment of other work shall be provided by the fabricator and detailed on the Shop Drawings.

D. All materials shall be properly worked and match-marked for field assembly.

3.03 DELIVERY, STORAGE AND HANDLING

A. Structural members shall be loaded in such a manner that they may be transported and unloaded without being over-stressed, deformed or otherwise damaged.

B. Structural aluminum members and packaged materials shall be protected from corrosion and deterioration. Material shall be stored in a dry area and shall not be placed in direct contact with the ground. Materials shall not be placed on the structure in a manner that might cause distortion or damage to the members or the supporting structures. The Contractor shall repair or replace damaged materials or structures as directed.

3.04 ERECTION

A. All temporary bracing, guys and bolts as may be necessary to ensure the safety of the structure until the permanent connections have been made shall be provided by the Contractor.

B. Structural members shall be set accurately to the lines and elevations indicated. The various members shall be aligned and adjusted to form a part of a complete frame or structure before being permanently fastened. A licensed civil engineer shall survey the structural aluminum during erection and shall provide a final survey indicating elevations and locations of all major members. Necessary adjustments to compensate for discrepancies in elevations and alignments shall be performed.

C. No cutting of structural aluminum members in the field will be allowed except by the written approval of the Engineer.

D. Bearing surfaces and other surfaces which will be in permanent contact shall be cleaned before assembly.

E. Field welding shall not be permitted unless specifically indicated in the Drawings or approved in writing by the Engineer. All field welding shall comply with Section 05050, Metal Fastening.

F. All bolted connections shall comply with Section 05050, Metal Fastening.

G. All field connections shall be accurately fitted up before being bolted. Drifting shall be only such as will bring the parts into position and shall not be sufficient to enlarge the holes or to distort the metal. All unfair holes shall be drilled or reamed.

H. Misfits at Bolted Connections

1. Where misfits in erection bolting are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misfit for review by the Engineer. The Engineer will determine whether the remedy is acceptable or if the member must be refabricated.

2. Incorrectly sized or misaligned holes in members shall not be enlarged by burning or by the use of drift pins. The Contractor shall notify the Engineer immediately and shall submit a proposed method of remedy for review by the Engineer.

3. Where misalignment between anchor bolts and bolt holes in aluminum members are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misalignment for review by the Engineer.

I. Grouting of Base Plates and Bearing Plates

1. The bottom surface of the plates shall be cleaned of all foreign materials, and concrete or masonry bearing surface shall be cleaned of all foreign materials and roughened to improve bonding.

2. Accurately set all base and bearing plates to designated levels with steel wedges or leveling plates.

3. Baseplates shall be grouted with non-shrink grout to assure full uniform bearing. Grouting shall be done prior to placing loads on the structure. Non-shrink grout shall conform to Section 03600, Grout.

4. Anchor bolts shall be tightened after the supported members have been positioned and plumbed and the non-shrink grout has attained its specified strength.

J. Where finishing is required, assembly shall be completed including bolting and welding of units before start of finishing operations.

3.05 PAINTING

A. Painting shall be performed according to Section 09900, Painting.

B. Aluminum surfaces in contact with concrete or dissimilar metals shall be thoroughly protected with two coats of epoxy paint with a minimum total thickness of 16 mils or other approved isolating material in accordance with the requirements of Section 09900 - Painting.

- END OF SECTION -

SECTION 05500

METAL FABRICATIONS

PART 1 -- GENERAL

1.01 REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all metal fabrications not specifically included in other Sections, complete and in accordance with the requirements of the Contract Documents.

B. Work shall include but may not be limited to lintels, guard posts, hoppers, and chutes.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05010 - Metal Materials

B. Section 05050 - Metal Fastening

C. Section 05035 - Galvanizing

D. Certain specific items are included in other Sections of the Specifications. See the section for the specific item in question.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of other requirements of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Building Code 6th Edition (2017)

2. AISC - Specification for Structural Steel Buildings

3. AISI - Specifications for the Design of Cold-Formed Steel Structural Members

4. Aluminum Association Specifications for Aluminum Structures

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01300, Submittals.

1. Complete fabrication and erection drawings of all metalwork specified herein.

2. Other submittals as required in accordance with Section 05010, Metal Materials, and Section 05050, Metal Fastening.

PART 2 -- PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used in metal fabrications shall conform to Section 05010, Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

A. All welds and fasteners used in metal fabrication shall conform to Section 05050, Metal Fastening, unless noted otherwise.

2.03 LINTELS

A. Provide lintels as shown on the Drawings and specified herein with 8 inches minimum bearing each side unless noted otherwise.

B. All lintels shall be steel in accordance with Section 05120, Structural Steel, and shall be galvanized in accordance with Section 05035, Galvanizing, unless noted otherwise.

2.04 GUARD POSTS (BOLLARDS)

A. Guard posts shall be 6-inch diameter Schedule 40 galvanized steel pipe in accordance with ASTM A53.

B. Guard posts shall be concrete filled and crowned, as detailed in the Drawings.

PART 3 -- EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.

E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05050, Metal Fastening. All fastenings shall be concealed where practicable.

G. Fabricated items shall be shop painted when specified in Section 09900, Painting.

3.02 INSTALLATION

A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.

B. All miscellaneous metalwork shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions

C. Metal work shall be field painted when as specified in accordance with Section 09900, Painting.

- END OF SECTION -

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SECTION 05510

METAL STAIRS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all metal stairs in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05010 - Metal Materials

B. Section 05035 - Galvanizing

C. Section 05050 - Metal Fastening

D. Section 05120 - Structural Steel

E. Section 05140 - Structural Aluminum

F. Section 05520 - Handrails and Railings

G. Section 05531 - Gratings, Access Hatches, and Access Doors

H. Section 05550 - Stair Treads and Nosings

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Building Code 6th Edition (2017)

2. AISC Specification for Structural Steel Buildings

3. AISI Specification for the Design of Cold-Formed Steel Structural Members

4. Aluminum Association Specifications for Aluminum Structures

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01300 - Submittals.

1. Complete fabrication and erection drawings of all metal work specified herein.

2. Other submittals as required in accordance with Section 05010 - Metal Materials, and Section 05050 - Metal Fastening.

PART 2 -- PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used for metal stairs shall conform to Section 05010, Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

A. All welds and fasteners used in metal stairs shall conform to Section 05050, Metal Fastening, unless noted otherwise.

2.03 METAL STAIRS AND LANDINGS

A. Stair stringers and structural framing of landings shall be fabricated from steel or aluminum as indicated on the Drawings.

1. Steel stairs shall be fabricated from steel in accordance with Section 05120, Structural Steel.

2. Aluminum stairs shall be fabricated from aluminum alloy 6061-T6 in accordance with Section 05140, Structural Aluminum.

B. Regardless of material of stringers, all stair treads shall be aluminum in accordance with Section 05550, Stair Treads and Nosings.

C. Where metal landings are required as indicated on the Drawings, gratings at landings shall conform to Section 05531, Gratings, Access Hatches, and Access Doors.

D. Handrails for metal stairs shall conform to Section 05520, Handrails and Railings. Contractor shall coordinate attachment of handrails to metal stairs.

E. All clips, anchors, and necessary appurtenances shall be provided for a complete and rigid installation.

F. Closure plates shall be provided for all exposed ends of stringers.

G. All exposed connections shall be welded and ground smooth, unless otherwise indicated on the Drawings.

H. Stairs and landings shall be designed to support a 100 psf live load, minimum, unless otherwise indicated on the Drawings.

2.04 STEEL PAN STAIRS

A. General

1. All steel stairs and landings with concrete filled steel pan risers and treads shall meet all applicable OSHA, ANSI, and NFPA codes.

2. Stair assemblies shall conform to the dimensions and arrangements shown on the Drawings.

3. Stair assemblies shall be designed to support a minimum 100 psf live load unless otherwise indicated on the Drawings.

4. Steel framing, hangers, columns, struts, clips, brackets, bearing plates, and other necessary appurtenances shall be provided for support of stairs and platforms as shown on the Drawings.

5. Exposed portions of steel pans, platforms, framing system stringers, and portions of aluminum nosings in contact with concrete, steel, or masonry shall be painted in accordance with Section 09900, Painting.

6. Concrete fill shall be 3-inches thick for platforms and 1-1/2 inches thick for pan treads.

7. Cast-in-place safety stair nosings in accordance with Section 05550, Stair Treads and Nosings, shall be provided for treads and platforms.

8. Metal pan treads, platforms, and risers shall be fabricated from 0.1084-inch thick (12 gauge minimum), galvanized structural steel sheets.

9. Risers and treads shall be supported by steel angle brackets welded to the stringers. Metal pans shall be secured to the brackets with welds.

10. Closure pieces shall be provided for ends of stringers.

B. Connections

1. All connections shall be welded unless otherwise shown on the Drawings or specified herein. All welds shall be continuous and ground smooth where exposed. Welding shall conform to Section 05050, Metal Fastening.

2. Assemblies shall be fabricated such that bolts and other fastenings do not appear on finished surfaces.

3. All joints shall be true and tight, and connections between parts shall be light-proof tight.

C. Handrails for steel pan stairs shall conform to Section 05520, Handrails and Railings. Contractor shall coordinate connection of handrails to stairs.

2.05 ALTERNATING TREAD STAIRS

A. Stairs, landings, and platforms shall be designed to carry a live load of 100 lbs. per square foot, unless noted otherwise on the Drawings.

B. The stairs shall be welded, alternating tread type stairs having a center spine and a cast integrally welded combination mounting plate and top landing, flush with the upper floor level. Handrails shall be custom formed and contoured to provide close body support and shall be welded on to the balusters which extend directly from the treads. All risers shall be equal, including the first and last risers, and treads shall have anti-skid surfaces. The stringer bottoms shall be bent and/or cut and welded to a floor plate. All exposed connections shall be welded and ground smooth.

C. Treads, floor plate castings, and landing shall be aluminum alloy AAF356F. Half treads shall be at least 9-inches wide and 10-inches deep. The central stringer shall be aluminum alloy 6063-T52, 1-3/4-inches x 4 inches x 1/8-inch box shape. Handrails shall be aluminum alloy 6061-T4. Finish shall be Aluminum Association M12C22A41.

D. The alternating tread type stairs shall be Model 68AL, as manufactured by Lapeyre Stair, Harahan, Louisiana, or equal.

PART 3 -- EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with all adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. Finished members shall conform to the lines, angles, and curves shown on the drawings and shall be free from distortions of any kind.

E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05050, Metal Fastening. All fastenings shall be concealed where practicable.

G. Fabricated items shall be shop painted when specified in accordance with Section 09900, Painting.

3.02 INSTALLATION

A. Assembly and installation of metal stairs shall be performed in strict accordance with manufacturer's recommendations.

B. All miscellaneous metalwork shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

C. Metal stairs shall field painted when specified in accordance with Section 09900, Painting.

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SECTION 05515

LADDERS

PART 1 -- GENERAL

1.01 REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all ladders in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05010 - Metal Materials

B. Section 05050 - Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents.

1. Florida Building Code 6th Edition (2017)

2. Aluminum Association Specifications for Aluminum Structures

3. Occupational Safety and Health Administration (OSHA) Regulations

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01300, Submittals.

1. Complete fabrication and erection drawings of all metalwork specified herein.

2. Other submittals as required in accordance with Section 05010, Metal Materials, and Section 05050, Metal Fastening.

PART 2 -- PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used for ladders shall conform to Section 05010, Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

A. All welds and fasteners used for ladders shall conform to Section 05050, Metal Fastening, unless noted otherwise.

2.03 LADDERS

A. Ladders shall be furnished with all mounting brackets, baseplates, fasteners, and necessary appurtenances for a complete and rigid installation.

B. All ladders shall be aluminum alloy 6061-T6 or 6063-T5, with a clear, anodized finish, Aluminum Association M12C22A41.

C. All ladders shall conform to dimensions indicated on the Drawings and shall comply with OSHA requirements.

D. Rungs shall be slip resistant.

E. All exposed connections shall be welded and ground smooth.

PART 3 -- EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.

E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05050, Metal Fastening. All fastenings shall be concealed where practicable.

G. Fabricated items shall be shop painted when specified in accordance with Section 09900, Painting.

3.02 INSTALLATION

A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.

B. All miscellaneous metalwork shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

C. Metalwork shall be field painted when specified in accordance with Section 09900, Painting.

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SECTION 05520

HANDRAILS AND RAILINGS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all handrails and railings in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05010 - Metal Materials

B. Section 05050 - Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Building Code 6th Edition (2017)

2. Aluminum Association Specifications for Aluminum Structures

3. Occupational Safety and Health Administration (OSHA) Regulations

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01300, Submittals.

1. Complete fabrication and erection drawings of all metal work specified herein.

2. Other submittals as required in accordance with Section 05010, Metal Materials and Section 05050, Metal Fastening.

PART 2 -- PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used for handrails and railings shall conform to Section 05010, Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

A. All welds and fasteners used in handrails and railings shall conform to Section 05050, Metal Fastening, unless noted otherwise.

2.03 HANDRAILS AND RAILINGS

A. General - Handrail systems shall consist of all railings, posts, toeboards, baseplates, anchors, and accessories required for a complete and rigid installation.

1. All handrail systems shall be fabricated from extruded aluminum alloy 6061-T6 or 6105-T5, with Aluminum Association M12C22A41 finish, unless otherwise noted.

2. Metal railings shall be fabricated from 1½ inch Schedule 40 pipe. Metal railing support posts shall be fabricated from 1½ inch Schedule 80 pipe.

3. The centerline of the top guard rail shall be 42 inches above the walking surface for level rail. For stair rail, the centerline of the top guard rail shall be 42 inches above the leading edge of the tread nosing. Stair handrail shall be 34 inches above the leading edge of the tread nosing.

4. Posts

a. Maximum horizontal spacing between posts for level rail shall be six feet.

b. Maximum horizontal spacing between posts for stair rail shall be five feet.

5. All rail joints shall be finished flush and shall occur only at supports. Posts shall not interrupt the continuation of the top rail at any point along the railing, including corners and end terminations. The top surface of the top railing shall be smooth and shall not be interrupted by projecting fittings.

6. Toeboards

a. Toeboards shall project 4-inches above the walking surface and shall not infringe on the minimum required walkway width.

b. Aluminum toeboards shall be extruded from aluminum alloy 6063-T6 unless otherwise noted.

c. Toeboards shall have a minimum thickness of 1/8" at any point. Geometry of toeboard shall closely resemble geometry shown on Drawings.

7. Expansion joint splices shall be provided at 30 foot maximum spacing and at all expansion joints in the structure supporting the handrail.

8. The handrail system shall be designed to resist the design loads specified by both OSHA and the International Building Code - 2000.

9. Provide handrail extensions at top and bottom of stairs and ramps in accordance with the Building Code.

B. For metal handrail, the Contractor shall have the option of providing a handrail system of either an all welded type construction or a component type construction.

1. With both the all welded or component type construction, the baseplates and toeboards shall be furnished as shown on the Drawings.

2. Component Type System

a. All fittings and brackets shall be designed for stainless steel concealed set screws with internal tyne type connectors.

b. Exposed fittings shall be cast or extruded aluminum, or stainless steel to match ladder material, except where corrosion-resistant steel is employed as a standard fabricator's item for use.

c. Component type handrail shall be as manufactured by Thompson Fabricating Company, Inc., or Hollaender Manufacturing Company, Inc.

3. Welded handrail may be field assembled using component type fittings as described herein.

C. Handrail shall be Type I handrail as shown on the Drawings.

1. Type I handrail shall be a two-rail system. The centerline of the intermediate rail shall be 21 inches above the walking surface.

D. Where gates are required in handrails as shown on the Drawings, they shall be self-closing and shall be provided by the same manufacturer as the handrail. Gates shall swing away from the opening being protected by the handrail.

E. Where safety chains are required in handrails as shown on the Drawings, chains shall be constructed of Type 304 stainless steel. Chains shall be straight link style, 3/16-inch diameter, with at least twelve links per foot, and with snap hooks on each end. Snap hooks shall be boat type and eye bolts for attachment of chains shall be 3/8-inch bolts with 3/4-inch eye diameter welded to the railing posts. Two (2) chains, four inches longer than the anchorage spacing shall be supplied for each guarded area.

2.04 FREE STANDING RAILING SYSTEM

A. Free standing railing system shall be installed on roof ledges where accessible equipment is provided on roof and roof does not have a perimeter parapet wall of a

minimum height of 42 inches. Free standing railing system shall be Safety Rail 2000 Guardrail System by BlueWater Mfg., Inc. or approved equal.

B. Toe Board brackets shall be used when the parapet wall is less than 3½" in height.

C. Performance Characteristics: Shall meet and exceed OSHA (Standards - 29 CFR) 1926.502 (b).

1. Railing System shall be designed to withstand a minimum 200 pounds of test load in any direction.

2. Railing System shall consist of a top rail and rail at mid height between top rail and walking surface.

3. Railing system shall extend to a height of at least 42" from the finished roof deck.

4. Railing system shall be free of sharp edges and snag points.

D. Railing and Base

1. Rail shall be 1⅝" O.D. Hot Rolled Pickled Electric Weld Tubing

2. Each support post shall have a free standing base cast from Class 30 Gray Iron material.

3. Each base shall have four (4) receiver posts for accepting the rails.

4. The receiver posts shall have a positive locking system. A friction locking system will not be acceptable.

5. The receiver posts shall have a slot to enable the rails to be mounted in any direction.

E. Hardware

1. The securing pins shall be made from 1010 carbon steel. The pins shall be zinc plated and yellow chromate dipped. The pins shall consist of a collared pin and a lanyard that connects to a lynch pin.

2. For Gate Assemblies Only. Bolts and washers shall be 3/8" x 3½" and 3/8" x 3" grade 5, zinc plated.

3. Finish: Rails: Specify factory finish Safety Yellow Powder Coat Paint, Hot Dipped Galvanized or a color to match the building.

Bases: Specify factory finish Safety Yellow Powder Coat Paint, Hot Dipped Galvanized or a color to match the building.

PART 3 -- EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with all adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. Finished members shall conform to the lines, angles, and curves shown on the drawings and shall be free from distortions of any kind.

E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

F. Concrete anchors and bolts for attachment of handrail baseplates to supporting members shall conform to Section 05050, Metal Fastening.

G. All fabricated items shall be shop painted in accordance with Section 09900, Painting.

3.02 INSTALLATION

A. Assembly and installation of handrails and railings shall be performed in strict accordance with manufacturer's recommendations.

B. All handrails and railings shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

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SECTION 05531

GRATINGS, ACCESS HATCHES, AND ACCESS DOORS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all gratings, floor plates, and hatches in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05010 - Metal Materials

B. Section 05035 - Galvanizing

C. Section 05050 - Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Building Code 6th Edition (2017)

2. Aluminum Association Specifications for Aluminum Structures

3. Occupational Safety and Health Administration (OSHA) Regulations

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01300, Submittals.

1. Complete fabrication and erection Drawings of all gratings, access hatches, and access doors specified herein.

2. Other submittals as required in accordance with Section 05010, Metal Materials, and Section 05050, Metal Fastening.

PART 2 -- PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used for gratings, floor plates, and hatches shall conform to Section 05010, Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

A. All welds and fasteners used for gratings, floor plates, and hatches shall conform to Section 05050, Metal Fastening, unless noted otherwise.

2.03 GRATING

A. General - Grating, including support frames, fastenings, and all necessary appurtenances for a complete installation, shall be furnished as indicated on the Drawings.

1. All exposed bearing ends of grating shall be enclosed in a perimeter band of the same dimensions and material as the main bars, including ends at all cutouts.

2. Grating shall be fabricated into easily removable sections and shall be fastened at each corner and as required with fasteners provided by the grating manufacturer. No fasteners shall be permitted to project above the walking surface.

3. Grating shall be designed for a loading of 150 psf unless otherwise required by the Drawings. Grating deflection shall not exceed 1/4 inch under a uniform load of 100 psf. Minimum grating depth shall be 1-1/2 inches, unless structural requirements based on clear span require more depth.

4. Grating installed in cast-in-place concrete shall be provided with embedded support frames on all perimeter and bearing edges. Support frames shall include anchor straps or headed studs at a maximum of 18” on-center, a minimum of two each side. Support frames shall be fabricated from the same material as the grating.

B. Aluminum Grating

1. Aluminum grating shall be of I-bar type and shall consist of extruded bearing bars positioned and locked by crossbars. All supports, cross members, etc. shall be aluminum. Plank clips for grating holddowns or other required attachments, shall be aluminum or stainless steel. Bolts shall be stainless steel. Provide embedded aluminum support frames for cast-in-place concrete installations.

2. Grating shall be “19-SI-4 I-Bar Swage Locked” by Alabama Metal Industries Corporation (AMICO), “IB” by Harsco Industrial IKG, “I-Bar 19SGI4", by Ohio Grating Inc., or “I-Bar” by Thompson Fabricating LLC.

C. Aluminum Plank Grating

1. Aluminum plank grating shall be unpunched planks of extruded aluminum welded together to form panels. Panel ends shall have an extruded aluminum end bar welded in place. All support members shall be aluminum. Plank clips for grating holddowns or other required attachments, shall be aluminum or stainless steel. Bolts shall be stainless steel. Provide embedded aluminum support frames for cast-in-place concrete installations.

2. Aluminum plank grating shall be HD-P manufactured by Harsco Industrial IKG., Heavy Duty Series manufactured by Ohio Gratings, Inc., or Unpunched Duo-Grip Extruded Series manufactured by Alabama Metal Industries Corporation (AMICO).

D. Heavy Duty Steel Grating

1. Heavy duty steel grating shall be galvanized according to Section 05035, Galvanizing.

2. Main bearing bars shall conform to ASTM A36. Cross bars shall be flush with the top of the grating. Provide embedded galvanized steel support frames for cast-in-place concrete installations.

3. Grating span shall be 36 inches maximum and shall satisfy AASHTO loading for H-20 truck.

4. Grating shall be manufactured by Harsco Industrial IKG, Alabama Metal Industries Corporation (AMICO), and Ohio Gratings, Inc.

2.04 ACCESS HATCHES

A. Access hatches shall be aluminum unless noted otherwise.

B. All access hatches shall be checker plate with an approved raised pattern, non-skid surface.

C. Access hatches shall be designed to carry a minimum live load of 150 psf, or a concentrated load of 300 pounds at the center, whichever produces the greatest stress.

D. Access hatches shall not exceed an allowable fiber stress of 16,000 psi. Live load deflection shall be limited to L/240 of the span, but not more than 1/4-inch.

E. All access hatches shall be fabricated from 1/4" plate, minimum and shall be stiffened as required to maintain allowable stress and deflection requirements specified herein. Stiffeners shall consist of angles or bars welded to the bottom of the plate.

F. Hinges, where indicated on the Drawings, shall be insulated, heavy-duty, cadmium plated bronze with stainless steel pins and fasteners.

G. All access hatches as indicated on the Drawings shall be provided with recessed handles. Handle material shall be as shown on the Contract Drawings.

H. Air-tight and water-tight access hatches shall be provided with a 1/8 inch thick neoprene gasket between the checkered plate and the support frame. Gasket material shall be bonded to the support frame and access hatches shall be bolted to the structural support frame with countersunk stainless steel flathead screws.

2.05 ACCESS DOORS

A. General

1. Door opening sizes, number and direction of swing of door leaves, and locations shall be as shown on the Drawings. The Drawings shall indicate the clear opening dimensions.

2. All doors shall be aluminum unless otherwise noted.

3. Openings larger than 42 inches in either direction shall have double leaf doors.

4. Doors shall be designed for flush mounting and for easy opening from both inside and outside.

5. All doors shall be provided with an automatic hold-open arm with release handle.

6. Double leaf doors shall be provided with safety bars to go across the open sides of the door, when in the open position. Brackets shall be provided on the underside of the doors to hold the safety bars when not in use.

7. All hardware, including but not limited to, all parts of the latch and lifting mechanism assemblies, hold open arms and guides, brackets, hinges, springs, pins, and fasteners shall be stainless steel.

8. All doors shall be watertight with a continuous gasket. All single door applications shall include a continuous EPDM odor reduction gasket.

9. Door frames shall be extruded and equipped with a 1-1/2 inch minimum drain pipe located by the manufacturer. The drain pipe shall be provided by the Contractor and shall extend to the nearest point of discharge acceptable to the Engineer.

B. Floor, Wet Well and Dry Pit Access Doors

1. Door leaves shall be 1/4 inch, minimum, diamond pattern plate with an approved raised pattern, non-skid surface. Plate shall be stiffened as required to maintain allowable stress and deflection requirements. Stiffeners shall consist of angles or bars welded to the bottom of plate.

2. Doors shall be designed for a 300 psf live load minimum, unless noted otherwise.

3. Doors shall be designed for flush mounting and for easy opening from both inside and outside.

4. All doors shall have an enclosed compression spring assist and open to 90 degrees.

5. Exterior doors shall be Type "J-AL" or "JD-AL", by Bilco Company, Type ”W1S” or “W2S” by Halliday Products Inc., Type "TPS" or "TPD", by U.S.F. Fabrication Inc., Type "THG" or "THG-D", by Thompson Fabricating LLC.

6. Interior doors shall be Type "K" or "KD", by Bilco Company, Type ”S1S” or “S2S” by Halliday Products Inc., Type "APS300" or "APD300", by U.S.F. Fabrication Inc., Type "TH" or "TH-D", by Thompson Fabricating LLC.

7. Doors rated for H-20 traffic loading shall be “JAL-HD” or “JDAL-HD” by the Bilco Company, Type “H1C” or “H2C” by Halliday Products, Inc., or Type “THS” or “THD” by U.S.F. Fabrication Inc.

C. Roof Access Doors

1. Doors shall be designed for 50 psf live load unless noted otherwise.

2. Doors for service stairs shall be Bilco Type L roof Scuttles.

3. Doors for ladder access shall be Bilco Type S or SS Roof Scuttles.

D. Fixed Ladders

1. Where the Contract Documents indicate fixed ladders are required under access doors, they shall be provided with “LadderUp, Model LU-4” by Bilco Company, “L1E Ladder Extension” by Halliday Products Inc., or “Ladder Climb-out Device” by Thompson Fabricating.

2. The safety posts shall be manufactured of the same material as the access door with telescoping tubular sections that lock automatically when fully extended.

3. Upward and downward movement shall be controlled by a stainless steel balancing mechanism.

4. Safety posts shall be assembled in strict accordance with manufacturer's recommendations.

2.06 FALL THROUGH PREVENTION SYSTEM

A. All access hatches and access doors covering openings measuring 12 inches or more in its least dimension through which persons may fall shall be equipped with a fall through prevention system, except where noted on the Contract Drawings. Access hatches and access doors shall be provided with a permanent installed fall through prevention grate system that provides continuous safety assurance in both its closed and open positions. The grate system shall be made with 6061-T6 aluminum or FRP and be designed for a 300 psf minimum liveload, unless noted otherwise.

PART 3 -- EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.

E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05050, Metal Fastening. All fastenings shall be concealed where practicable.

3.02 INSTALLATION

A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.

B. All gratings, access hatches, and access doors shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions. Embedded support frames shall be set level and square.

C. Grating shall not be field cut or modified unless approved by Engineer.

D. Grating shall not be used for equipment support or anchorage.

- END OF SECTION -

SECTION 05550

STAIR TREADS AND NOSINGS

PART 1 -- GENERAL

1.01 REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all stair treads and nosings in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05010 - Metal Materials

B. Section 05050 - Metal Fastening

C. Section 05510 - Metal Stairs

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Building Code 6th Edition (2017)

2. Aluminum Association Specifications for Aluminum Structures.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01300, Submittals.

1. Complete fabrication and erection drawings of all work specified herein.

2. Other submittals as required in accordance with Section 05010, Metal Materials, and Section 05050, Metal Fastening.

PART 2 -- PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used for stair treads and nosings shall conform to Section 05010, Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

A. All welds and fasteners used for stair treads and nosings shall conform to Section 05050, Metal Fastening, unless noted otherwise.

2.03 SAFETY STAIR NOSINGS

A. Abrasive cast aluminum, safety stair nosings shall be provided on all concrete or concrete filled steel pan stairs, including the top stair of metal stairs that attach to concrete, and as shown on the Drawings unless noted otherwise.

B. Nosing shall be 3 inches wide and shall extend the full width of the stairway minus 3 inches on either side. Nosing shall be cast into the concrete and held in place with butterfly type extruded anchors.

C. The nosing shall be "Style 231-A", by Amstep Products, “Alumogrit Type 101", by Wooster Products, Inc., "Type AX", by Safe-T-Metal Company. For steel pan concrete filled stairs, nosing shall be "Type 101-SP", Wooster Products, Inc., or "Type AXPE", by Safe-T-Metal Company. For pan stairs, nosing shall be continuous over corner of stair treads to fully protect corner of treads from abrasion. All exposed fasteners shall be Type 304 stainless steel.

2.04 STAIR TREADS

A. Stair treads shall be aluminum with an abrasive nosing as shown on the Drawings.

B. Stair treads shall be designed for the live load specified in Section 05510, Metal Stairs.

C. Stair treads shall be as manufactured by IKG Industries, or Safe-T-Metal Company.

2.05 FRP STAIR NOSINGS

A. FRP stair nosings shall be provided on all concrete stairs in sodium hypochlorite areas and as indicated on the Drawings.

2.06 FRP STAIR TREADS

A. FRP stair treads shall be provided for FRP stairs in sodium hypochlorite areas and as indicated on the Drawings.

PART 3 -- EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, connections, brackets, and other details necessary for a complete installation shall be provided.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

E. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05050, Metal Fastening. All fastenings shall be concealed where practicable.

3.02 INSTALLATION

A. Assembly and installation of stair treads and nosings shall be performed in strict accordance with manufacturer's recommendations.

B. All stair treads and nosings shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

- END OF SECTION -

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DIVISION 7

Thermal and Moisture Protection

SECTION 07190

VAPOR BARRIER

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish labor, material, equipment and appliances required for complete execution of Work.

B. Principal items of work include:

1. Vapor barrier below structural slabs on grade.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03300 - Cast-in-Place Concrete

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01300 - Submittals, submit the following:

1. Manufacturer's data and installation instructions.

PART 2 -- PRODUCTS

2.01 VAPOR BARRIER

A. Vapor Barrier: A reinforced laminate membrane with a minimum tensile strength of 75 lbs/in. in accordance with ASTM D-882, vapor transmission rating of 0.02 perms in accordance with E-96, and a puncture resistance of 25 lbs in accordance with ASTM D-4833.

B. Adhesive/Tape: Type approved by the Manufacturer of the vapor material.

C. Penetration sealing: Provide manufacturer’s recommended penetration seals at all pipe, conduit, and similar penetrations.

2.02 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Specifications, provide products from one of the following manufacturers:

1. Viper Vapercheck 10 by Insulation Solutions, Inc.

2. Griffolyn Type-85, by Reef Industries, Inc.

3. Or Equal

PART 3 -- EXECUTION

3.01 VAPOR BARRIER

A. Vapor barrier shall be placed on top of 4 inches minimum of compacted structural fill stone, free of debris and protrusions for structural slabs.

B. Lap edges 12 inches and seal with adhesive tape. Lay with seams perpendicular to and lapped in the direction of placement. Do not penetrate vapor barrier.

C. Protect from damage until concrete is placed. Punctures and tears in vapor barrier shall be repaired using patches of the material which overlaps puncture or tear a minimum of 12 inches; seal with tape or adhesive.

D. Penetrations through vapor barrier, such as pipe, drains, conduits and similar penetrations, shall be sealed in strict accordance with manufacturer's recommended instructions.

- END OF SECTION -

SECTION 07900

JOINT FILLERS, SEALANTS AND CAULKING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish labor, materials, equipment and appliances required for the complete execution of Work shown on the Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03250 - Concrete Accessories

B. Section 03290 - Joints in Concrete

C. Section 08800 - Glass and Glazing

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. ASTM C-920 Elastomeric Joint Sealants

2. ASTM D-1056 Flexible Cellular Materials - Sponge or Expanded Rubber

3. SWRI Sealant and Caulking Guide Specification

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01300 – Submittals, submit the following:

1. Manufacturers literature and installation instructions.

2. Color samples of each type of sealant.

1.05 QUALITY ASSURANCE

A. Applicator shall be a company specializing in the installation of sealants with a minimum of five years experience.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in unopened labeled packages.

B. Store materials in location protected from freezing or damages.

C. Reject and remove from the site materials within broken or damaged packaging.

PART 2 -- PRODUCTS

2.01 MATERIALS

A. Sealants

1. Type 1: Multi-component, non-sag, low-modulus polyurethane rubber sealant meeting ASTM C-920, Type M, Grade NS, Class 25, use NT, M, A, and O. Capable of withstanding 50% in extension or compression such as Sikaflex-2C NS/SL, Sika Corporation, or Sonolastic NP-2, Sonneborn, or DynaTrol II by Pecora Corporation.

2. Type 2: Single component polyurethane sealant meeting ASTM C-920, Type S, Grade NS, Class 25, Use NT, M, A, and O. Capable of withstanding 25% in extension or compression such as Sikaflex 1A by Sika Corporation, DynaTrol 1-XL by Pecora Corporation, or Sonolastic NP-1 by BASF Construction Chemicals.

3. Type 3: Single component, low-modulus moisture curing silicone meeting ASTM C-920, Type S, Grade NS, Class 25, Use NT, M, G, and A. Capable of withstanding 50% extension and compression. Pecora 890 by Pecora Corporation, Sonolastic Omni Seal by BASF Construction Chemicals.

4. Type 4: Single component, mildew resistant, moisture-curing silicone meeting ASTM C-920, Type S, Grade NS, Class 25, Use NT, M, G, and A. Pecora 898 by Pecora Corporation, Sonolastic Omni Plus by BASF Construction Chemicals.

5. Type 5: Single component, acrylic latex meeting ASTM C-834. AC-20+ Silicone by Pecora Corporation, Sonneborn Sonolac by BASF Construction Chemicals.

6. Type 6: High grade butyl sealant meeting Federal Specification TT-S-00-1657. BC-158 by Pecora Corporation or equal.

7. Type 7: Multi-component chemical resistant polysulfide sealant conforming to ASTM C-920, Type M, Grade NS, Class 25 such as Deck-O-Seal by W.R. Meadows, Tammsflex by DuraJoint Concrete Accessories, or Synthacalk GC2+ by Pecora Corporation.

8. Type 8: Nonsag, Multi Component, traffic grade polyurethane sealant meeting ASTM C920, Type 19, Grade NS, Class 25, use T, M, A, and O. DynaTread by Pecora Corporation, Sonolastic Ultra by BASF Construction Chemicals.

B. Primer: Non-staining primer recommended by sealant manufacturer for the substrates on this project.

C. Backer Rod: Closed cell foam, nonreactive with caulking materials, non-oily, and approved by the sealant manufacturer. Minimum density shall be 2.00 pounds per cubic foot. Use no asphalt or bitumen-impregnated fiber with sealants.

D. Joint Cleaner: Recommended by sealant or caulking compound manufacturer.

E. Bond breaker: Either polyethylene film or plastic tape as recommended by the sealant manufacturer.

F. Color: Where manufacturer's standard colors do not closely match materials being sealed, provide a custom color.

PART 3 -- EXECUTION

3.01 QUALITY CONTROL

A. Coordinate work with details shown on approved shop drawings prepared by other trades.

B. Verify conditions in the field.

C. Schedule work to follow closely the installation of other trades.

D. Apply sealants and related items in temperatures and dry conditions recommended by the manufacturers.

E. Do not paint sealant, unless recommended by sealant and paint manufacturer.

3.02 PREPARATION

A. Protect finished surfaces adjoining by using masking tape or other suitable materials.

B. Clean and prime joints before starting any caulking or sealing work.

C. Thoroughly clean joints and spaces of mortar and other foreign materials. Cleaning agent shall be Xylol or similar non-contaminating solvent to remove any film from metal surfaces. Masonry or concrete surfaces shall be brushed or air jet cleaned.

D. Joint Requirements

1. All joints and spaces to be sealed in exterior work shall be less than 1/2 inch deep and not less than 1/4 inch wide. If joints in masonry are less than that specified herein, the mortar shall be cut out to the required width and depth. All joints and spaces to receive sealant shall be completely prepared and thoroughly dry before installation of sealant.

2. Unless otherwise specified, joints and spaces which are open to a depth of 1/2 inch or greater shall be solidly filled with back-up material to within 1/4 inch of the surface. Back-up material shall be packed tightly and made continuous throughout the length of the joints. Bond breaker shall be applied as required. If joints are less than 1/4 inch deep, the back-up material may be omitted, a bond breaker substituted and the joint completely filled with sealant. The back-up material shall not project beyond

the 1/4 inch depth of the open space in any joint. The following width-to-depth ratio table shall be adhered to, unless otherwise recommended by manufacturer.

Joint Width	Sealant Depth	
	Minimum	Maximum
¼ inch	1/4 inch	1/4 inch
Over 1/4 inch to 1/2 inch	1/4 inch	Equal to width
Over 1/2 inch to 1 inch	1/2 inch	Equal to width
Over 1 inch to 2 inches	1/2 inch	1/2 of width

3.03 APPLICATION

A. Exercise care before, during, and after installation so as not to damage any material by tearing or puncturing. All finished work shall be approved before covering with any other material or construction.

B. Apply sealant by an approved type of gun except where the use of a gun is not practicable, suitable hand tools shall be used. Avoid applying the compound to any surface outside of the joints or spaces to be sealed. Mask areas where required to prevent overlapping of sealant.

C. All joints shall be waterproof and weathertight.

D. Point sealed joints to make a slightly concave joint, the edges of which are flush with the surrounding surfaces. Exposed joints in the interior side of the door and other frames shall be neatly pointed flush or to match adjacent jointing work.

E. Adjacent materials which have been soiled shall be cleaned immediately and the work left in neat and clean condition.

F. Comply with sealant manufacturer's written instructions except where more stringent requirements are shown or specified and except where manufacturer's technical representative directs otherwise.

3.04 ADJUSTMENT AND CLEANING

A. Remove misplaced sealant compounds promptly using methods and materials recommended by the manufacturer, as the work progresses.

B. Allow sealants to cure and remove protective edging, of doors, louvers, saddles windows etc. as directed by the Engineer.

3.05 SCHEDULE

Schedule of Sealants

Application	**Sealant**	**Color**
Vertical and horizontal expansion and construction joints in concrete structures unless noted otherwise herein or on Drawings.	Type 1	To closely match adjacent surfaces or mortar and as selected by the Owner.

Application	Sealant	Color
Vertical and horizontal joints bordered on both sides by masonry, precast concrete, natural stone or other porous building material, unless noted otherwise herein or on Drawings.	Type 2	To closely match adjacent surfaces or mortar and as selected by the Owner.
Vertical and horizontal joints bordered on both sides by painted metals, anodized aluminum, mill finished aluminum, PVC, glass or other non-porous building material.	Type 3	To closely match adjacent surfaces and as selected by the Owner.
Masonry expansion and control joints less than 1¼" wide.	Type 2	To closely match adjacent surfaces and as selected by the Owner.
Masonry expansion and control joints equal or greater than 1¼ inches wide and not to exceed 2".	Type 1	To closely match adjacent surfaces and as selected by the Owner.
Interior – wood trim and finish joints.	Type 5	Color to be selected by Owner
Sanitary areas, joints in ceramic tile, around plumbing fixtures, countertops, and back splashes. See Note 1.	Type 4	To closely match adjacent surfaces and as selected by the Owner.
Perimeter sealing of doors, windows, louvers, piping, ducts, and electrical conduit. See Note 2.	Type 2 OR Type 3	To closely match adjacent surfaces and as selected by the Owner.
Below thresholds.	Type 6	Manufacturer's standard
Submerged in liquids. See Note 4.	Type 1	Manufacturer's standard
Submerged in liquids with high concentration of chlorine (> 2 ppm).	Type 7	Manufacturer's standard
Horizontal Joints exposed to vehicular or pedestrian traffic.	Type 8	To closely match adjacent surfaces.
Other joints indicated on the drawings or customarily sealed but not listed.	Type recommended by manufacturer	To closely match adjacent surfaces and as selected by the Owner.

Note 1. Sealant for Laboratory Countertop shall be as recommended by countertop manufacturer.

Note 2. Provide UL approved sealants for penetrations thru fire-rated walls and as specified in Section 07270.

Note 3. Sealants which will come in contact with potable water shall meet the requirements of NSF 61.

Note 4. Where sealant will be immersed in liquid chemicals verify compatibility prior to installation of sealant.

- END OF SECTION -

DIVISION 9

Finishes

SECTION 09900

PAINTING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall furnish all labor, tools, materials, supervision, and equipment necessary to do all the work specified herein and as required for a complete installation, including surface preparation, priming, and painting of CONTRACTOR furnished equipment, materials, and structures.

1.02 GENERAL INFORMATION AND DESCRIPTION

A. All paint for concrete and metal surfaces shall be especially adapted for use around wastewater treatment plants and shall be applied in conformance with the manufacturer's published specifications.

B. All paint for final coats shall be fume resistant, compounded with pigments suitable for exposure to gases, especially to hydrogen sulfide, chlorine, and to carbon dioxide. Pigments shall be materials which do not tend to darken, discolor, or fade due to the action of raw water and disinfection gases. If a paint manufacturer proposes use of paint which is not designated "fume resistant" in its literature, it shall furnish full information concerning the pigments used in this paint.

C. Coatings used in conjunction with potable water supply systems shall have U.S. Environmental Protection Agency (EPA), National Science Foundation (NSF), and Food and Drug Administration (FDA) approval for use with potable water and shall not impart a taste or odor to the water.

D. The term "paint", as used herein, includes emulsions, enamels, paints, stains, varnishes, sealers, cement filler, cement-latex filler, and other coatings, whether used as prime, intermediate, or finish coats.

E. All surfaces as specified herein shall be painted with not less than one (1) shop coat for equipment, one field prime coat, followed by the specified number of field finish coat(s) of the appropriate paint. Items to be painted include, but are not limited to, existing and new exterior and interior concrete, structural steel, miscellaneous metals, pipe, fittings, valves, mechanical equipment, motors, and conduit, and all other work in and around the existing headworks structure and new RAS Control Valve Stations, including the existing grit pumps.

F. Baked-on enamel finishes and items with standard shop finishes such as graphic panels, electrical equipment, instrumentation, etc., shall not be field painted unless the finish is damaged during shipment or installation. Aluminum, stainless steel, fiberglass, and bronze work shall not be painted unless color coding and marking is required or otherwise specified. A list of surfaces not to be coated is included in Article 1.09.

G. The CONTRACTOR shall obtain all permits, licenses, and inspections and shall comply with all laws, codes, ordinances, rules, and regulations promulgated by authorities having jurisdiction which may bear on the work. This compliance will include Federal Public Law 91-596 more commonly known as the "Occupational Safety and Health Act of 1970".

1.03 MANUFACTURERS

A. All painting materials shall be as manufactured by Ameron, Carboline, PPG, Tnemec, Sherwin Williams, or equal.

1.04 SUBMITTALS AND SERVICES

A. The CONTRACTOR shall submit paint manufacturer's data sheets and samples of each finish and color to the ENGINEER for review, before any work is started in accordance with Section 01300 entitled “Submittals”.

B. Submitted samples of each finish and color shall be prepared so that areas of each sample indicate the appearance of the various coats. For example, where a three-coat system is specified, the sample shall be divided into three areas indicating one coat only, two coats, and all three coats. The ENGINEER will provide written authorization constituting a standard, as to color and finish only, for each coating system.

C. The CONTRACTOR shall prepare a complete schedule of surfaces to be coated and shall identify the surface preparation and paint system he proposes to use. The paint schedule shall be in conformance with Article 3.07. The schedule shall contain the name of the paint manufacturer and the name, address and, telephone number of the manufacturer's representative that will inspect the work. The schedule shall be submitted to the ENGINEER for review as soon as possible following the Notice to Proceed so that the schedule may be used to identify colors and to specify shop painting systems on order for fabricated equipment.

D. Name and detailed qualifications of the protective coatings applicator or subcontractor. Qualifications shall include, but not be limited to, five (5) references which show that the painting applicator or subcontractor has previous successful experience with the specified or comparable coating systems, a list of installations that are currently in service and documentation that applicator or subcontractor is currently a qualified applicator or the proposed coatings by the manufacturer.

1.05 SERVICES OF MANUFACTURERS REPRESENTATIVE

A. The CONTRACTOR shall purchase paint from an acceptable manufacturer. The manufacturer shall assign a representative to inspect the application of his product both at the shop and in the field. Prior to and after coating application, the manufacturer's representative shall submit reports to the ENGINEER identifying the products used and verifying that said products were proper for the exposure and service intended and were properly applied, respectively.

B. Services shall also include, but not be limited to, inspecting prior coatings of paint, determination of best means of surface preparation, inspection of completed work, and final inspection of painted work to be performed six (6) months after the job is completed.

1.06 MANUFACTURERS' INSTRUCTIONS

A. The manufacturer’s published instructions for use as a guide in specifying and applying the manufacturer’s proposed paint shall be submitted to the ENGINEER. Paint shall not be delivered to the job before acceptance of the manufacturer’s instructions is given by the ENGINEER.

B. A manufacturer's paint will not be considered for use unless that manufacturer's published instructions meet the following requirements:

C. The instructions must have been written and published by the manufacturer for the purpose and with the intent of giving complete instruction for the use and application of the proposed paint in the locality and for the conditions for which the paint is specified or shown to be applied under this Contract.

D. All limitations, precautions, and requirements that may adversely affect the paint; that may cause unsatisfactory results after the painting application; or that may cause the paint not to serve the purpose for which it was intended, that is, to protect the covered material from corrosion, shall be clearly and completely stated in the instructions. These limitations and requirements shall, if they exist, include, but not be limited to the following list:

1. Methods of application
2. Number of coats
3. Thickness of each coat
4. Total thickness
5. Drying time of each coat, including primer
6. Primer required to be used
7. Primers not permitted
8. Use of a primer
9. Thinner and use of thinner
10. Temperature and relative humidity limitations during application and after application
11. Time allowed between coats

12. Protection from sunlight

13. Physical properties of paint including solids content and ingredient analysis

14. Surface preparation

15. Touch up requirements and limitations

1.07 QUALITY ASSURANCE

A. The CONTRACTOR shall give the ENGINEER a minimum of three (3) days advance notice of the start of any field surface preparation work or coating application work.

B. All such work shall be performed only in the presence of the ENGINEER, unless the ENGINEER has specifically allowed the performance of such work in his absence.

C. Inspection by the ENGINEER, or the waiver of inspection of any particular portion of the work, shall not relieve the CONTRACTOR of his responsibility to perform the work in accordance with these Specifications.

D. Where protective coatings are to be performed by a subcontractor, said subcontractor must provide five (5) references which show that the painting subcontractor has previous successful experience with the specified or comparable coating systems. Include the name, address, and the telephone number for the OWNER of each installation for which the painting subcontractor provided the protective coating.

1.08 SAFETY AND HEALTH REQUIREMENTS

A. In accordance with requirements of OSHA Safety and Health Standards for Construction (29CFR1926) and the applicable requirements of regulatory agencies having jurisdiction, as well as manufacturer's printed instructions, appropriate technical bulletins, manuals, and material safety data sheets, the CONTRACTOR shall provide and require use of personnel protective and safety equipment for persons working in or about the project site.

B. Respirators shall be worn by persons engaged or assisting in spray painting. The CONTRACTOR shall provide ventilating equipment and all necessary safety equipment for the protection of the workmen and the work.

C. All paint shall comply with all requirements of the Air Pollution Regulatory Acts concerning the application and formulation of paints and coatings for an area in which the paints are applied. Specifically, paints shall be reformulated as required to meet the local, State and Federal requirements.

1.09 SURFACES NOT TO BE COATED

A. The following items shall not be coated unless otherwise noted.

1. Encased or buried piping or conduit.

2. Stainless steel surfaces.

3. Aluminum handrails, grating, covers, structural members, and plate.

4. Flexible rubber couplings, lubricated bearing surfaces, and insulation.

5. Packing glands and other adjustable parts of mechanical equipment.

6. Finish hardware.

7. Switch plates and receptacle plates.

8. Signs, nameplates, serial numbers, and operating instruction labels.

9. Any code-requiring labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.

10. Any moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sensing devices, motor and fan shafts, unless otherwise indicated.

11. FRP surfaces provided with an exterior gel-coat surface.

12. Galvanized surfaces of the structural steel members of the pre-engineered metal building unless the coating is damaged during installation. Galvanized surface coatings damaged during shipping, handling, erection, or due to construction activities shall be repaired in full conformance to ASTM A780 Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

1.10 QUALITY WORKMANSHIP

A. The CONTRACTOR shall be responsible for the cleanliness of his painting operations and shall use covers and masking tape to protect the work whenever such covering is necessary, or if so requested by the COUNTY. Any unwanted paint shall be carefully removed without damage to any finished paint or surface. If damage does occur, the entire surface, adjacent to and including the damaged area, shall be repainted without visible lapmarks and without additional cost to the COUNTY.

B. Painting found defective shall be scraped or sandblasted off and repainted as the COUNTY may direct. Before final acceptance of the work, damaged surfaces of paint shall be cleaned and repainted as directed by the COUNTY.

C. Any pipe scheduled to be painted and having received a coating of a tar or asphalt compound shall be painted with two (2) coats or "Inertol Tar Stop", "Tnemec Tar Bar" or equal before successive coats are applied in accordance with the paint schedule.

1.11 ADDITIONAL PAINT

A. At the end of the project, the CONTRACTOR shall turn over to the COUNTY one (1) five-gallon can of each type and color of paint, primer, thinner, or other coating used in the field painting. If the manufacturer packages the material concerned in gallon cans, then it shall be delivered in unopened labeled cans as it comes from the factory. If the manufacturer does not package the material in gallon cans and in the case of special colors, the materials shall be delivered in new gallon containers, properly closed with typed labels indicating brand, type, color, etc. The manufacturer's literature describing the materials and giving directions for their use shall be furnished in three (3) bound copies. A type-written inventory list shall be furnished at the time of delivery.

1.12 SHIPPING, HANDLING AND STORAGE

A. All painting materials shall be brought to the job site in the original sealed labeled containers of the paint manufacturer and shall be subject to review by the ENGINEER. Where thinning is necessary, only the product of the manufacturer furnishing the paint shall be used. All such thinning shall be done strictly in accordance with the manufacturer's instructions, and with the full knowledge of the ENGINEER.

B. Materials and their storage shall be in full compliance with the requirements of pertinent codes and fire regulations. Receptacles shall be placed outside buildings for paint gates and containers. Paint waste shall not be disposed of in plumbing fixtures, process drains or other plant systems or process units.

PART 2 -- PRODUCTS

2.01 MATERIALS

A. Table 09900-1 depicts the coatings referenced in Article 3.07, "Paint Schedule".

Table 09900-1
Product Listing

Reference Number	Description	Manufacturers Reference (TNEMEC)
100	Drywall Primer	51 PVA Sealer
104	Polyamidoamine Epoxy Primer	N69 – 1211
105	Polyamidoamine Epoxy	N69 – Hi Build Epoxoline II
107	Waterborne Acrylic Epoxy	113 – Color
109	Acrylic	6 – Color Tneme-Cryl
110	Acrylic Polyurethane	1074U Endurashield
111	Modified Waterborne Acrylate	156 - Envirocrete (Smooth Texture)

115	Aromatic Urethane, Zinc Rich	90-97 Tneme-Zinc
116	Water repellent	668 Chemprobe Deck A Pell 40
117	Modified Polyamine Epoxy	215 Surfacing Epoxy
118	Polyamide Epoxy – Coal Tar	Series 46H-413 Hi-Build Tneme-Tar
122	Aromatic Urethane, Hydro Rich	94-H20 Hydro Zinc
137	Silicate Blend	629 CT Densifyer
138	Polyamine Novolac Epoxy	282 Tneme-Glaze
139	Modified Polyamine Epoxy	201 Epoxoprime
140	Modified Aliphatic Polyaspartic	256 Excellathane
141	Epoxy Modified Cementitious Mortar	218 MortarClad
142	Polyamine Epoxy Base Coat	270 Stranlok

A. No lead containing protective coating materials shall be used on this project.

B. Table 09900-1 lists Tnemec products as a reference. Equivalent products by the manufacturers listed in Article 1.03 of this Section may be submitted for review.

PART 3 -- EXECUTION

3.01 SHIPPING, HANDLING AND STORAGE

A. All painting materials shall be brought to the job site in the original sealed labeled containers of the paint manufacturer and shall be subject to inspection by the ENGINEER. Packages shall not be opened until they are inspected by the ENGINEER and required for use. Where thinning is necessary, only the product of the manufacturer furnishing the paint shall be used. All such thinning shall be done strictly in accordance with the manufacturer's instructions and with the full knowledge of the ENGINEER.

B. Materials and their storage shall be in full compliance with the requirements of pertinent codes and fire regulations. All painting materials shall be stored in a clean, dry, well-ventilated place protected from sparks, flame, direct rays of the sun, or excessive heat. Receptacles shall be placed outside buildings for paint gates and containers. Paint waste shall not be disposed of in plumbing fixtures, process drains or other plant systems or process units.

3.02 INSPECTION OF SURFACES

A. Before application of the prime coat and each succeeding coat, all surfaces to be painted shall be subject to inspection by the ENGINEER. Any defects or deficiencies shall be corrected by the CONTRACTOR before application of any subsequent coating.

B. Samples of surface preparation and of painting systems shall be furnished by the CONTRACTOR to be used as a standard throughout the job, unless omitted by the ENGINEER.

C. When any appreciable time has elapsed between coatings, previously coated areas shall be carefully inspected by the ENGINEER, and where, in his opinion, surfaces are damaged or contaminated, they shall be cleaned and recoated at the CONTRACTOR's expense. Recoating times of manufacturer's printed instructions shall be adhered to.

D. Coating thickness shall be determined by the use of a properly calibrated "Nordson-Mikrotest" (or equal) dry mil thickness gauge.

3.03 EQUIPMENT

A. Effective oil and water separators shall be used in all compressed air lines serving spray painting and sandblasting operations to remove oil or moisture from the air before it is used. Separators shall be placed as far as practicable from the compressor.

B. All equipment for application of the paint and the completion of the work shall be furnished by the CONTRACTOR in first-class condition and shall comply with recommendations of the paint manufacturer.

C. The CONTRACTOR shall provide free of charge to the ENGINEER two (2) "Nordson-Mikrotest" dry film gauges to be used to inspect coating by ENGINEER and CONTRACTOR. Gauges may be used by CONTRACTOR and returned each day to the ENGINEER. ENGINEER will return gauges to CONTRACTOR at completion of the job.

3.04 PREPARATION OF MATERIALS

A. Mechanical mixers, capable of thoroughly mixing the pigment and vehicle together, shall mix the paint prior to use where required by manufacturer's instructions. Thorough hand mixing will be allowed for small amounts up to five gallons.

B. Pressure pots shall be equipped with mechanical mixers to keep the pigment in suspension, when required by manufacturer's instructions. Otherwise, intermittent hand mixing shall be done to assure that no separation occurs. All mixing shall be done in accordance with Steel Structures Painting Council (SSPC) Vol. 1, Chapter 4, "Practical Aspects, Use and Application of Paints" and/or with manufacturer's recommendations.

C. Catalysts or thinners shall be as recommended by the manufacturer and shall be added or discarded strictly in accordance with the manufacturer's instructions.

3.05 SURFACE PREPARATION

A. <u>General</u>

1. Paint surface preparation shall be as specified in the following or recommended by the paint manufacturer's published application instructions, whichever imposes the most stringent requirements.

2. Surfaces to be painted shall be clean, dry, and free of dust, rust, scale and all foreign matter. No solvent cleaning, power, or hand tool cleaning shall be permitted unless approved by the ENGINEER or specified herein.

3. Except as otherwise provided, all preparation of metal surfaces shall be in accordance with Specifications SP-1 through SP-10 of the SSPC. Where Steel Structures Painting Specifications are referred to in these Contract Documents, the corresponding Pictorial Surface Preparation Standard shall be used to define the minimum final surface conditions to be supplied. Grease and oil shall be removed and the surface prepared by hand tool cleaning, power tool cleaning, or blast cleaning in accordance with the appropriate SSPC SP-1 through SP-10.

4. Weld flux, weld spatter, and excessive rust scale shall be removed by power tool cleaning as per SSPC-SP-3.

5. Threaded portions of valve and gate stems, machined surfaces which are intended for sliding contact, surfaces which are to be assembled against gaskets, surfaces or shafting on which sprockets are to fit, or which are intended to fit into bearings, machined surfaces of bronze trim on slide gates, and similar surfaces shall be masked off to protect them from the sandblasting of adjacent surfaces. Cadmium-plated or galvanized items shall not be sandblasted unless hereinafter specified, except that cadmium-plated, zinc-plated, or sherardized fasteners used in assembly of equipment to be sandblasted shall be sandblasted in the same manner as the unprotected metal. All installed equipment, mechanical drives, and adjacent painted equipment shall be protected from sandblasting. Protection shall prevent any sand or dust from entering the mechanical drive units or equipment where damage could be caused.

6. Hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place prior to cleaning and painting, and not intended to be painted, shall be protected or removed during painting operations and repositioned upon completion of painting operations.

7. Any abraded areas of shop or field applied coatings shall be touched up with the same type of shop or field applied coating, even to the extent of applying an entire coating, if necessary. Touch-up coatings and surface preparations shall be in addition to and not considered as the first field coat.

8. Sand from sandblasting shall be thoroughly removed, using a vacuum cleaner if necessary. No surface, which has been sandblasted, shall be painted until inspected by the ENGINEER.

B. Exposed Pipe, Valves and Pumps: Bituminous coated pipe shall not be used in fully exposed locations. Pipe, valves, and pumps which shall be fully exposed after project completion shall be primed in accordance with the requirements herein. Any

bituminous coated ferrous pipe which is inadvertently installed in exposed locations shall be sandblasted to SSPC-SP-5 White Metal before priming and painting. After installation, all exterior, exposed flanged joints shall have the gap between adjoining flanges sealed with a single component Thiokol caulking to prevent rust stains.

C. Ferrous Metal Surfaces

1. All ferrous metal surfaces not required to be galvanized shall be cleaned of all oil, grease, dirt, rust, and tight and loose mill scale by blasting in accordance with the following: SSPC-SP-10 Near White Metal Blast Cleaning with a 2 - 3 mil profile. Priming/Painting shall follow sandblasting before any evidence of corrosion occurs.

2. Field surface preparation of small, isolated areas such as field welds, repair of scratches, abrasions or other marks to the shop prime or finish shall be cleaned by power tools in accordance with SSPC-SP-3, or in difficult and otherwise inaccessible areas by hand cleaning in accordance with SSPC-SP-2 and spot primed.

D. Primed or Coated Surfaces and Non-Ferrous Surfaces: All coated surfaces shall be cleaned prior to application of successive coats. All non-ferrous metals not to be coated shall be cleaned. This cleaning shall be done in accordance with SSPC-SP-1, Solvent Cleaning.

E. Shop Finished Surfaces: All shop-coated surfaces shall be protected from damage and corrosion before and after installation by treating damaged areas immediately upon detection. Abraded or corroded spots on shop-coated surfaces shall be prepared in accordance with SSPC-SP-2, Hand Tool Cleaning and then touched up with the same materials as the shop coat. All shop coated surfaces which are faded, discolored, or which require more than minor touch-up, in the opinion of the ENGINEER, shall be repainted. Cut edges of galvanized sheets, electrical conduit, and metal pipe sleeves, not to be finish painted, shall be cleaned in accordance with SSPC-SP-1, Solvent Cleaning and primed with zinc dust-zinc oxide metal primer.

F. Galvanized, Zinc and Copper Alloy Surfaces: All copper or galvanized metal surfaces shall be given one coat of metal passivator or metal conditioner before applying the prime coat. The passivator or conditioner shall be compatible with the complete paint system and shall be as identified on the paint schedule.

G. Concrete and Masonry Surfaces

1. Concrete and masonry surfaces to be painted shall be prepared by removing efflorescence, chalk, dust, dirt, grease, oil, form coating, and tar and by roughening to remove glaze. All surfaces shall be repaired prior to commencement of the coating operation. Concrete and masonry surfaces are to be cured for at least 28 days prior to coating them. Apply clear sealer prior to painting.

2. All rinse water shall be collected and properly disposed. The rinse water may only be discharged to the plant drains after being properly neutralized. Neutralization procedures must be approved in advance by the ENGINEER.

3. Submerged concrete surfaces that are to be painted shall be etched with 15 percent to 10 percent muriatic acid solution to produce the necessary "sandpaper texture" surface required for satisfactory adherence of the paint. Surfaces must be flushed and scrubbed with water to remove acid residue and particles loosened by it. Acid shall not be allowed to dry on surfaces.

4. Concrete surfaces specified by the paint manufacturer to be acid etched shall be etched in accordance with the manufacturer's instructions. The surface shall then be thoroughly scrubbed with clean water, rinsed, and allowed to dry. The surface shall be tested with a moisture meter to determine when dry before coating.

H. PVC Pipe Surfaces: Prior to painting, all PVC pipe surfaces shall be cleaned per SSPC-SP-1, followed by a light sanding with medium weight sandpaper. The pipe shall be free of sanding dust prior to painting.

3.06 Shop Painting

A. All fabricated steel work and equipment shall receive, at the factory, at least one (1) shop coat of prime paint compatible with the paint system required by these specifications. Surface preparation prior to shop painting shall be as specified. Finish coat(s) may be applied in the shop if approved by the ENGINEER. All shop painted items shall be properly packaged and stored until they are incorporated in the work. Any painted surfaces that are damaged during handling, transporting, storage, or installation shall be cleaned, scraped, and patched before field painting begins so that the work shall be equal to the original painting received at the shop. Equipment or steel work that is to be assembled on the site shall likewise receive a minimum of one (1) shop coat of paint at the factory. Surfaces of exposed members that will be inaccessible after erection shall be prepared and painted before erection.

B. The CONTRACTOR shall specify the shop paints to be applied when ordering equipment in order to assure compatibility of shop paints with field paints. The paints and surface preparation used for shop coating shall be identified on shop drawings submitted to the ENGINEER for review. Shop paint shop drawings will not be reviewed until the final project paint system has been submitted by the CONTRACTOR and reviewed by the ENGINEER.

C. Shop finish coat(s) may be the standard finish as ordinary applied by the manufacturer if it can be demonstrated to the ENGINEER that the paint system is equal to and compatible with the paint system specified.

3.07 Paint Schedule

A. General: The CONTRACTOR shall adhere to this paint schedule, providing those paints named or approved equal. DFT shall mean the total minimum dry film thickness per application measured in mils. Products are referenced by numbers listed in Article 2.01, “Materials,” and listed in Table 09900-1.

B. Metal Surfaces, Atmospheric Exposure

1. Metal surfaces exposed to the atmosphere that do not come into contact with wastewater or corrosive gasses including the following types of surfaces shall be painted as described below:

   a. Pumps, fans, motors, machinery, etc.

   b. Above ground piping, including ductile iron pipe, valves, hydrants, and pipe supports.

   c. Miscellaneous steel shapes, angles, etc that do not have a factory applied or field repaired hot dip galvanized coating.

   d. Exposed non-factory painted surfaces of electric panels, conduit, ventilation fans, air conditioning units, duct work, etc.

   Surface Preparation: SSPC-SP6 Commercial Blast

Application	No.	Description	DFT
First -1 coat	115	Aromatic Urethane Zinc Rich	2.0 - 4.0
Second	105	Polyamidoamine Epoxy	4.0 - 6.0
Finish - 1 coat	110	Acrylic Polyurethane	2.0 - 3.0
		Min. Total	10.0 Mils

C. Metal Surfaces, Submerged Exposure

1. Metal surfaces that are submerged in wastewater or subjected to corrosive gases (interior of Plant Drain PS Wet Well), including the following types of surfaces, shall be painted as follows:

   a. Pumps and motors.

   b. Piping, including ductile iron pipe, valves and supports.

   c. Miscellaneous steel shapes, angles, rails, etc. that do not have a factory applied or field repaired hot dip galvanized coating.

   Surface Preparation: SSPC-SP5

Application	No.	Description	DFT
First – 1 coat	122	Aromatic Urethane, Hydro Zinc	3.0 – 3.5
First coat	105	Polyamidoamine Epoxy	4.0 – 6.0
Finish - 1 coat	117	Modified Polyamine Epoxy	18.0 – 22.0
		Min. Total	27.0 Mils

D. PVC Piping and Appurtenances

1. All new aboveground PVC pipes, valves, and accessories shall receive the following types of paint:

Interior

Application	No.	Description	DFT
Finish - 1 coat	105	Polyamidoamine Epoxy	4.0 - 6.0

Exterior

Application	No.	Description	DFT
First - 1 coat	105	Polyamidoamine Epoxy	2.0 - 3.0
Finish - 1 coat	110	Aliphatic Acrylic Polyurethane	2.0 - 3.0
		Min. Total	6.0 Mils

E. New Concrete, Exposed Vertical and Ceiling Surfaces

1. The exterior above grade column, beam, and ceiling surfaces of the new dewatering structure and electrical building exterior shall receive the following:

Application	No.	Description	DFT
First - 1 coat	111	Modified Waterborne Acrylate	4.0 - 6.0
Finish - 1 coat	111	Modified Waterborne Acrylate	4.0 - 6.0
		Min. Total	10.0 Mils

F. Gypsum Wallboard Surfaces

1. All exposed gypsum board in the new electrical room shall be factory painted as follows (this coating is to be applied under Section 13400):

Application	No.	Description	DFT
Primer	100	Drywall Primer	1.0
First - 1 coat	109	Acrylic	1.0 - 2.0
Second - 1 coat	107	Waterborne Acrylic Epoxy	2.0 - 3.0
Finish - 1 coat	107	Waterborne Acrylic Epoxy	2.0 - 3.0
		Minimum Total	7.0 Mils

G. New Concrete, Exposed Exterior Covered Traffic Bearing Slab Surfaces

1. Exposed top of slab concrete surfaces of the lower level truck loading drive through area of the new dewatering structure (other than the trench interior) and exterior side of exposed chemical containment walls shall be coated as follows:

Application	No.	Description	DFT
Finish - 1 coat	116	Water Repellent	150 SFT/Gal

H. New Concrete, Exposed Exterior Uncovered Slab Surfaces

1. Exposed top of slab concrete surfaces of the new sludge pump slab and other outdoor equipment or stair landing pads shall be coated as follows:

Application	No.	Description	DFT
First - 1 Coat	137	Dustproofer	300 SF/Gal
Finish - 1 coat	137	Dustproofer	350 SFT/Gal

I. New Concrete, Exposed Exterior and Interior Operations Area Slab/Floor Surfaces

1. Top of slab for the polymer storage and feed area (other than the trench interior), top of slab for the upper level of the new dewatering structure, and the interior floor of the electrical room, including sides and tops of equipment pads shall be coated as follows:

Application	No.	Description	DFT
First - 1 coat	138	Polyamine Novolac Epoxy	6.0 – 8.0
Finish - 2 coats *	138	Polyamine Novolac Epoxy	6.0 – 8.0
		Min. Total	14.0 Mils

* Apply final coat with roller for orange peel finish other than areas to be coated to provide non-skid surface as noted in Item J below.

J. Non-Skid Walkways on Coated Surfaces (Item I Above):

1. Provide a non-skid adhesive floor walkway on the upper floor coated surface of the dewatering structure from the entry way at the stair landing, between the open hole area to the electrical room building, between the open hole area and the electrical room building over to the centrifuge, and 40” around the centrifuge as follows:

Application	No.	Description	DFT
Bring termination grooves to Level using Series 201 mixed with fumed silica	139	Polyamine Novolac Epoxy	1/2”
First – 1 coat	139	Polyamine Novolac Epoxy, tinted to match topcoat color	10.0-12.0

While wet, broadcast Series 201 with 30/50 mesh sand to rejection. Sweep and remove excess			
Finish – 1 coat	140	Modified Aliphatic Polyaspartic, tinted to match basecoat color	8.0 – 16.0 mils, depending on owner's texture preference
		Min. Total	14.0 Mils

K. Concrete Surfaces for Secondary Containment Of Chemicals

1. Provide a protective coating for the new hypochlorite and biosulfite storage and feed containment structures for all exposed new concrete surfaces within containment area and on top of perimeter containment walls (see Item G for exterior of containment walls) as follows:

   Surface Preparation: Allow concrete to cure at least 28 days. Abrasive blast-clean per SSPC-SP13.

Application	No.	Description	DFT
Surfacer *	141	Epoxy Modified Cementitious Mortar	1/16-inch
First Coat	139	Modified Polyamine Epoxy **	6-10 mils
Primer	142	Polyamine Epoxy **	25-40 mils
Finish Coat	138	Polyamine Novolac Epoxy **	6-10 mils
		Min. Total	48.0 Mils

   * Surfacer shall be applied on vertical surfaces

   ** Epoxy novalac system shall be designed for severe chemical exposure service (as shown on the Drawings). Solids content shall be 100 percent by volume. Please refer to manufacturer's recommendations for joints and horizontal to vertical transitions.

   Prior to use, the completed system shall be subjected to at least 48 hours of curing time with the concrete temperature at a minimum of 75 degrees F, or 96 hours at a minimum of 60 degrees F, both conditions at a maximum relative humidity of 50 percent and under forced ventilation conditions. More curing time or a higher

temperature shall be provided by CONTRACTOR if recommended by the epoxy novalak coating manufacturer. Other combinations of curing time and temperature may be used if the coating manufacturer presents satisfactory documentation and test results to substantiate that the degree of curing is equal or greater than curing for 240 hours at 70 degrees F.

Coating shall not be started until after the covered structure is in place to keep the system out of full sun exposure.

L. Aluminum in Contact with Concrete

1. All aluminum members in contact with concrete shall be coated as follows:

Application	No.	Description	DFT
First - 1 Coat	118	Polyamide Epoxy – Coal Tar	7.0 – 9.0
Finish - 1 coat	118	Polyamide Epoxy – Coal Tar	7.0 – 9.0
		Minimum Total	16.0 Mils

3.08 PAINTING

A. Application: All paint shall be applied by experienced painters with top quality, properly styled brushes, rollers, or other applicators reviewed by the ENGINEER and the paint manufacturer.

1. Paint shall be applied without runs, sags, thin spots, or unacceptable marks. Paints shall be applied at the rate specified by the manufacturer to achieve the minimum dry mil thickness required. Additional coats of paint shall be applied, if necessary, to obtain thickness specified. Work which shows carelessness, lack of skill, or is defective in the opinion of the ENGINEER, shall be corrected at the expense of the CONTRACTOR.

2. Paint shall be applied with spraying equipment only on those surfaces designated by the ENGINEER. If the material has thickened or must be diluted for application by spray gun, each coat shall be built up to the same film thickness achieved with undiluted brushed-on material. Where thinning is necessary, only the products of the particular manufacturer furnishing the paint shall be used; and all such thinning shall be done in strict accordance with the manufacturer's instructions, as well as with the full knowledge of the ENGINEER.

3. Surfaces not accessible to brushes or rollers may be painted by spray by dauber or sheepskins and paint mitt. If any of these methods is to be used, it shall be done in strict accordance with the manufacturer's instruction, as well as with the full knowledge of the ENGINEER.

B. Drying Time: A minimum of twenty four (24) hours drying time shall elapse between application of any two coats of paint on a particular surface unless shorter time periods

are a requirement of the manufacturer or specified herein. Longer drying times shall be required for abnormal conditions as defined by the manufacturer.

C. Weather Restrictions: No painting whatsoever shall be accomplished in rainy or excessively damp weather when the relative humidity exceeds 85 percent, or when the general air temperature cannot be maintained at 50 degrees Fahrenheit or above throughout the entire drying period. No paint shall be applied when it is expected that the relative humidity will exceed 85 percent or that the air temperature will drop below 50 degrees Fahrenheit within 18 hours after the application of the paint. Dew or moisture condensation should be anticipated; and if such conditions are prevalent, painting shall be delayed until midmorning to be certain the surfaces are dry. The day's painting shall be completed well in advance of the probable time-of-day when condensation will occur.

D. Inspection Between Coats: Each and every field coat of priming and finishing paint shall be inspected by the ENGINEER or his authorized representative before the succeeding coat is applied. The CONTRACTOR shall follow a system of tinting successive paint coats so that no two coats for a given surface are exactly the same color. Areas to receive black protective coatings shall in such cases be tick-marked with white or actually gauged as to thickness when finished. Magnetic dry film thickness gauges and wet fiber thickness gauges will be utilized for quality control. Coatings will also be required to pass a 64-volt holiday detector test.

E. Special Areas: All surfaces which are to be installed against concrete, masonry, etc., and will not be accessible for field priming and/or painting shall be back primed and painted as specified herein, before erection. Anchor bolts shall be painted before the erection of equipment and then the accessible surfaces repainted when the equipment is painted.

1. Special attention shall be given to ensure that edges, corners, crevices, welds, and rivets receive a film thickness equivalent to that of the adjacent painted surfaces.

3.09 SCHEDULE OF COLORS

A. All colors shall be designated by the COUNTY during shop drawing review. The CONTRACTOR shall submit color samples to the ENGINEER as specified in Article 1.04. The CONTRACTOR shall submit suitable samples of all colors (including custom colors as may be required) and finishes for the surfaces to be painted, or on portable surfaces when required by the ENGINEER. The ENGINEER shall decide upon the choice of colors and other finishes when alternates exist. No variation shall be made in colors without the COUNTY'S approval. Color names and/or numbers shall be identified according to the appropriate color chart issued by the manufacturer of the particular product in question.

B. Lee County Utilities standard colors for structures, equipment, and piping shall be provided. Color samples and descriptions shall be as listed in Section 15030.

3.10 COLOR CODING AND LETTERING OF PIPING

A. Pipe color coding and lettering are specified in Section 15030.

3.11 ANSI AND OSHA SAFETY COLORS

A. Items specified in the following subsections shall be safety color coated as specified. ANSI colors shall conform to (OSHA) ANSI Z53.1 and latest revisions. Materials shall be compatible with the system specified for the equipment, concrete, etc. Where a coating system is not specified and safety colors are required, the items shall be coated with a primer and two coats Glid-Guard Alkyd Industrial Enamel, or equal.

B. Red: Items listed in ANSI Z53.1, Section 2.1 shall be painted ANSI Red. In general, these items shall include fire protection equipment and apparatus; wall mounted breathing apparatus, danger signs and locations; and stop bars, buttons, or switches. In addition, all hose valves and riser pipes, fire protection piping and sprinkler systems, and electrical stop switches shall be painted ANSI Red.

C. Orange: Items listed in ANSI Z53.1, Section 2.2 shall be painted ANSI Orange. ANSI Orange shall be used as a basic color for designating dangerous parts of machines or energized equipment which may cut, crush, shock, or otherwise injure and to emphasize such hazards when enclosure doors are open or when gear belt or other guards around moving equipment are open or removed, exposing unguarded hazards. In addition, moving machinery having a linear or peripheral speed in excess of 10 feet per minute, which is either inadequately guarded due to physical problems or may be operated with the guard removed, rims or sprockets, gears, pulleys, etc.; crossheads of large engines and compressors; and flywheels shall be coated ANSI Orange.

D. Yellow: Items listed in ANSI Z53.1, Section 2.3 shall be painted ANSI Yellow. Yellow shall be the basic color for designating caution and for marking physical hazards such as striking against, stumbling, falling, tripping, and "caught in between". In addition, an 8-inch wide strip on the top and bottom tread of stairways shall be coated.

E. Green: Items listed in ANSI Z53.1, Section 2.4 shall be painted ANSI Green. Green shall be the basic color for designating safety and the location of first-aid equipment. In general, gas masks, first-aid kits, eye wash facilities, and safety deluge showers shall be coated with ANSI Green.

F. Blue: Blue shall be used for designating caution, limited to warning against the starting, the use of, or the movement of equipment under repair or being worked upon.

G. Purple: Items listed in ANSI Z53.1, Section 2.5 shall be painted ANSI Purple. In general, atomic sludge density meters shall be coated ANSI Purple.

3.12 WORK IN CONFINED SPACES

A. The CONTRACTOR shall provide and maintain safe working conditions for all employees. Fresh air shall be supplied continuously to confined spaces through the combined use of existing openings, forced-draft fans, or by direct air supply to individual workers. Paint fumes shall be exhausted to the outside from the lowest level in the contained space.

B. Electrical fan motors shall be explosion proof if in contact with paint fumes. No smoking or open fires will be permitted in, or near, confined spaces where painting is being done.

3.13 CLEANING

A. The CONTRACTOR shall protect at all times, in areas where painting is being done, floors, materials of other crafts, equipment, vehicles, fixtures, and finished surfaces adjacent to paint work. Cover all electrical wall plates, surface hardware, nameplates, gauge glasses, etc., before start of painting work.

B. At completion of the work, remove all paint where spilled, splashed, splattered, sprayed or smeared on all surfaces, including glass, light fixtures, hardware, equipment, painted and unpainted surfaces.

C. The buildings and all other work areas shall be at all times kept free from accumulation of waste material and rubbish caused by the work. At the completion of the painting, all tools, equipment, scaffolding, surplus materials, and all rubbish around and inside the buildings shall be removed and the work left broom clean unless otherwise specified.

- END OF SECTION –

DIVISION 10

Specialties

SECTION 10400

IDENTIFYING DEVICES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all labor, materials, equipment and appliances required for the complete execution of the Work as shown on the Drawings and specified herein.

B. Principal items of work include:

1. Plastic engraved and aluminum area and equipment signs

2. Warning, Caution, and Safety signs

1.02 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01300 - Submittals, submit the following:

1. Color and style examples for all nameplates and signs

2. Shop Drawings shall include, but not be limited to:

a. Complete catalog information and details for all signs and nameplates giving materials and fabrication details.

b. Complete schedules for all nameplates and signs giving location, message, letter, size, color, and method of attachment.

c. Details of attachment for all signs and nameplates.

1.03 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials in unopened, unbroken and undamaged original packaging bearing the manufacturer's label and identification for installation.

B. Handle all materials with care to prevent defacement of any nature.

1.04 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Specifications, provide products from one of the following manufacturers:

1. Andco Industries Corporation

2. Innerface Architectural Signage Incorporated
3. Environmental Sign Systems
4. Neiman & Company Architectural Signs
5. or approved equal

PART 2 -- PRODUCTS

2.01 FIRE EXTINGUISHER SIGNS

A. Furnish and install signs above each fire extinguisher. Signs shall have white raised letters chemically fused to 1/8-inch red acrylic plastic background. Signs to be 1 1/2-inch high x length required reading "FIRE EXTINGUISHER".

2.03 EXTERIOR STRUCTURE AND WARNING SIGNS

A. Provide and install exterior structure signs mounted as noted below, suitable for outdoor installation in Florida. All letters shall be Helvetica upper case style, minimum 4" high lettering, with a baked enamel color finish in contrasting colors for lettering and background as selected by Owner. Materials shall be baked enamel on aluminum. Minimum size of sign shall be such to allow at least 1" space to the edges from the engraved lettering on all sides. Provide Type 316 stainless steel concrete anchors for mounting signs to concrete and Type 316 stainless steel bolts, nuts, and washers for mounting to metal building sides.

SIGN LETTERING	LOCATION
DEWATERING PROCESS	Centered on exterior of upper level beam, north side of dewatering structure
DEWATERING PROCESS	Centered on exterior of upper level beam, south side of dewatering structure
HYPOCHLORITE STORAGE AND FEED SYSTEM	Centered on south side of chemical feed structure, exterior of the hypochlorite tanks,10' above grade
BISULFITE STORAGE AND FEED SYSTEM	Centered on south side of chemical feed structure, exterior of the future extension,10' above grade
NON-POTABLE WATER DO NOT DRINK	On vertical surface or aluminum post adjacent to all new hose bibb locations
CAUTION * CLEARANCE XX'-XX"	Centered on truck loading conveyor, hung with stainless steel chain from stainless steel eye hooks embedded in upper level beam, north side
CAUTION * CLEARANCE XX'-XX"	Centered on truck loading conveyor, hung with stainless steel chain from stainless steel eye hooks embedded in upper level beam, south side

*

Adjust value for height clearance to 2” lower than bottom of discharge chutes, catwalk, or other device, whichever is lowest.

2.04 EQUIPMENT LABELS

A. Provide equipment and panel labels as specified under Division 16 and Division 17 for electrical equipment, control panels, and instruments. Provide equipment signs as noted below in baked enamel on aluminum materials, suitable for outdoor installation in Florida. Lettering shall be Helvetica upper case style, 1” high lettering, with a baked enamel color finish in contrasting colors for lettering and background as selected by Owner. Minimum size of sign shall be such to allow at least 0.25” space to the edges from the engraved lettering. Provide Type 316 stainless steel hardware for mounting the signs or an approved adhesive. Exact location of sign and mounting method to be determined in the field by the Owner. Provide aluminum or fiberglass mounting stand as noted.

SIGN LETTERING	LOCATION
DEWATERING CENTRIFUGE	Centered on west side of centrifuge
SLUDGE FEED PUMP 1	On pump disconnect
SLUDGE FEED PUMP 2	On pump disconnect
SLUDGE GRINDER 1	On grinder disconnect
SLUDGE GRINDER 1	On grinder disconnect
POLYMER FEEDER 1	On east side of feeder enclosure
POLYMER FEEDER 2	On east side of feeder enclosure
HYDRAULIC BACK DRIVE	On west side of back drive assembly
OIL LUBE SYSTEM	On west side of oil lube system
AIR COMPRESSOR	On side of compressor frame above tank
ELECTRICAL ROOM	On exterior of active leaf door, eye level, centered
WASHWATER BOOSTER PUMP	On aluminum stand near pump
HYPOCHLORITE TANK 1	On FRP stand, east side of tank 1
HYPOCHLORITE TANK 2	On FRP stand, east side of tank 1
HYPOCHLORITE FEED PUMPS	On pump skid, back side, centered near top

PART 3 -- EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Beginning of installation means installer accepts existing surfaces.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install signs after doors and surfaces are finished, in locations indicated.

C. Clean signs and polish.

D. All materials specified herein shall be installed in compliance with the approved manufacturer's printed specifications. Mounting devices, bolts, screws, nuts and the like shall be of high strength aluminum or stainless steel. The final location of each sign shall be as determined by the Engineer.

3.02 ADJUSTMENT AND CLEANING

A. After completion of project, remove all protective devices, touch up as necessary and clean all exposed surfaces with a mild solution of detergent and warm water. Leave all surfaces in a neat and clean condition.

- END OF SECTION -

SECTION 10522

FIRE EXTINGUISHERS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish and install fire extinguishers as shown on the Drawings and specified herein.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of these Specifications the Work shall conform to the applicable requirements of the following documents:

1. NFPA 10 - Portable Fire Extinguishers

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01300, Submittals, submit the following:

1. Complete detail and installation drawings for Fire Extinguisher Cabinets.

2. Manufacturer's data sheets and verification of U.L. ratings.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Specifications provide products from one of the following manufacturers:

1. Kidde Fire Extinguisher Company

2. Ansul Fire Protection

3. Potter - Roemer

4. J. L. Industries

2.02 MATERIALS

A. Dry Chemical (DC) Fire Extinguishers

1. Provide where indicated on drawings, 10 lb. capacity, hand portable, with wall mount, tri-class dry chemical type, with Underwriters' Laboratories rating of 4-A: 60 BC.

B. Cabinet: Surface mounted cabinets #4 finish 304 stainless steel, Dual Vertical door with 1/8-inch thick DSA glass size. Doors shall be minimum of 1/2" thick. Hardware shall include pull handle, self-adjusting roller catch and continuous piano hinge constructed of stainless steel.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Fire extinguishers shall be installed where directed by the Engineer.

B. Wall mounts for extinguishers shall be securely mounted to masonry with lag bolts and shields.

C. Fire extinguishers shall be installed so that the top of the fire extinguisher is not more than 5 feet above the floor.

- END OF SECTION -

SECTION 10524

EMERGENCY SHOWER/EYEWASH STATIONS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish and install emergency shower/eyewash stations as shown on the Drawings and as specified herein. Coordinate work in this Section with painting and marking as specified in Section 09900, Painting. Certain equipment items will be field located by Owner, if not otherwise shown on the Drawings.

1.02 SUBMITTALS

A. Submit Shop Drawings, Performance Affidavit, Operation and Maintenance Instructions and other information as specified for all items of equipment in this Section in accordance with Section 11000, Equipment General Provisions and Section 01300, Submittals. Shop Drawings shall also include complete erection, installation, and adjustment instructions and recommendations.

1.03 MANUFACTURERS

A. The materials covered by these Specifications are intended to be standard equipment of proven reliability and as manufactured by reputable manufacturers having experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings and operated per manufacturers' recommendations.

PART 2 -- PRODUCTS

2.01 EMERGENCY SHOWER/EYEWASH STATIONS

A. Combination shower and eyewash stations shall be installed where shown on the Contract Drawings.

B. Emergency shower and eyewash shall be constructed of 1-1/4" SCH80 pipe and fittings with Type 316 stainless steel ball valves, all coated with a green epoxy finished and mounted on a PVC floor flange. Eye/face wash valve shall be designed to operate with the simple push of a hand flag. Shower ball valve shall be designed to operate with the pull of a triangular lever. Units shall be provided with a PVC dust cover to protect eyewash head from collecting dust before use. Units shall be pre-built and fully water/pressure tested to ensure no leaks and proper function. Shower head and eyewash shall be 11" round PVC with the same epoxy coating. Shower head shall provide equal distribution of water throughout the entire footprint of flow. Unit shall be

provided with a green and yellow ABS plastic high visibility sign. Units shall be installed per details on the Drawings and in accordance with manufacturer's recommendations. Units shall be Haws Model 8336 PVC plastic combination shower and eye/face wash, or approved equal.

A. Emergency shower and eyewash shall be provided with an emergency alarm system that shall consist of the following components:
   1. 1-1/4-inch Brass body, in-line, double pole, double throw flow switch rated for 120 V, 60 Hz. Switch shall activate at 2.4 gpm.
   2. Flashing amber light and 90 db (at 10 feet) buzzer
   3. NEMA 4X
   4. Haws Model 9001

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Emergency shower/eyewash stations shall be installed where shown on the Drawings or as directed by the Engineer. Where required by OSHA regulations, the background of the mounting location shall be painted the appropriate color.

- END OF SECTION -

SECTION 10525

CHEMICAL HANDLING SAFETY EQUIPMENT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish and install chemical handling safety equipment as shown on the Drawings and as specified herein. Coordinate work in this Section with painting and marking as specified in Section 09900, Painting. Certain equipment items will be field located by Owner, if not otherwise shown on the Drawings.

1.02 SUBMITTALS

A. Submit Shop Drawings, Performance Affidavit, Operation and Maintenance Instructions and other information as specified for all items of equipment in this Section in accordance with Section 11000, Equipment General Provisions and Section 01300, Submittals. Shop Drawings shall also include complete erection, installation, and adjustment instructions and recommendations.

1.03 MANUFACTURERS

A. The materials covered by these Specifications are intended to be standard equipment of proven reliability and as manufactured by reputable manufacturers having experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings and operated per manufacturers' recommendations.

PART 2 -- PRODUCTS

2.01 CHEMICAL HANDLING SAFETY EQUIPMENT

A. Chemical Handling Safety Equipment shall include respirators, chemical splash goggles, and chemical resistant work aprons, gloves and boots as manufactured by Fisher Scientific, Mine Safety Appliances, or equal.

B. Respirators shall be twin replaceable cartridge-type bearing NIOSH approval. Cartridges shall be as recommended by the manufacturer. Three (3) complete respirator units each with six replacement cartridges shall be provided.

C. Chemical splash goggles shall have soft vinyl frames with optical quality, distortion-free, replaceable plastic lenses. Three (3) splash goggles shall be provided.

D. Chemical resistant work aprons and gloves shall be cloth with a double coating of abrasion-resistant and chemical resistant elastomer. Chemical resistant boots shall have non-slip soles and steel shank and toe and shall be coated with a chemical resistant elastomer. Sizes of gloves and boots shall be selected by the Owner. Three (3) complete sets of aprons, gloves and boots shall be provided.

E. Chemical Handling Safety Equipment shall be stored in a wall-mounted double door steel cabinet of approved size to prevent cramping of equipment specified. Cabinet shall be field located as directed by the Engineer.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Chemical handling safety equipment shall be installed where shown on the Drawings or as directed by the Engineer. Where required by OSHA regulations, the background of the mounting location shall be painted the appropriate color.

- END OF SECTION -

DIVISION 11

Equipment

SECTION 11000

EQUIPMENT GENERAL PROVISIONS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, test, and place in acceptable operation all mechanical equipment and all necessary accessories as specified herein, as shown on the Drawings, and as required for a complete and operable system.

B. The mechanical equipment shall be provided complete with all accessories, special tools, spare parts, mountings, and other appurtenances as specified, and as may be required for a complete and operating installation.

C. It is the intent of these Specifications that the Contractor shall provide the County complete and operational equipment/systems. To this end, it is the responsibility of the Contractor to coordinate all interfaces with related mechanical, structural, electrical, instrumentation and control work and to provide necessary ancillary items such as controls, wiring, etc., to make each piece of equipment operational as intended by the Specifications.

D. The complete installation shall be free from excessive vibration, cavitation, noise, and oil or water leaks.

E. The requirements of this section shall apply to equipment furnished under Divisions 11, 13, 14, and 15.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. All equipment, materials, and installations shall conform to the requirements of the most recent editions with latest revisions, supplements, and amendments of the specifications, codes, and standards listed in Section 01090, Reference Standards.

1.03 PERFORMANCE AFFIDAVITS

A. When required in the individual equipment Specifications, the Contractor shall submit manufacturer's Performance Affidavits for equipment to be furnished.

B. By these affidavits, each manufacturer must certify to the Contractor and the County, jointly, that he has examined the Contract Documents and that the equipment, apparatus, or process he offers to furnish will meet in every way the performance requirements set forth or implied in the Contract Documents.

C. The Contractor must transmit to the Engineer three (3) original copies of the affidavit given him by the manufacturer or supplier along with the initial Shop Drawing submittals.

D. The Performance Affidavit must be signed by an officer of the basic corporation, partnership, or company manufacturing the equipment and witnessed by a notary public.

E. The Performance Affidavit shall have the following format:

Addressed to: (Contractor) and Lee County Utilities (County)

Reference: Lee County Utilities Fiesta Village WRF Dewatering and Sodium Hypochlorite System Improvements

Text: (Manufacturer's Name) has examined the Contract Documents and hereby state that the (Product) meets in every way the performance requirements set forth or implied in Section ____ of the Contract Documents.

Signature: Corporate Officers shall be Vice President, or higher. (Unless statement authorizing signature is attached.)

1.04 SHOP DRAWINGS

A. Shop Drawings shall be submitted to the Engineer for all equipment in accordance with Section 01300, Submittals and shall include the following information in addition to the requirements of Section 01300, Submittals:

1. Performance characteristics and descriptive data.

2. Detailed equipment dimensional drawings and setting plans.

3. General lifting, erection, installation, and adjustment instructions, and recommendations.

4. Complete information regarding location, type, size, and length of all field welds in accordance with "Standard Welding Symbols" AWS A2.0 of the American Welding Society. Special conditions shall be fully explained by notes and details.

5. The total uncrated weight of the equipment plus the approximate weight of shipped materials. Support locations and loads that will be transmitted to bases and foundations. Exact size, placement, and embedment requirements of all anchor bolts.

6. Details on materials of construction of all components including applicable ASTM designations.

7. Information on bearing types and bearing life.

8. Gear box design and performance criteria and AGMA service factor.

9. Piping schematics.

10. Motor data sheet indicating motor horsepower; enclosure type; voltage; insulation class; temperature rise and results of dielectric tests; service-rating; rotative speed; motor speed-torque relationship; efficiency and power factor at 1/2, 3/4 and full load; slip at full load; running, full load, and locked rotor current values; and safe running time-current curves.

11. Equipment and motor protective device details. Connection diagrams for motor and all protective devices.

12. Equipment shop coating systems, interior and exterior.

13. Panel layout drawings, schematic wiring diagrams, and component product data sheets for control panels. Refer to Division 17.

14. A list of spare parts and special tools to be provided.

15. Any additional information required to show conformance with the equipment specifications.

16. Warranty documentation including statement of duration of warranty period and contact phone numbers and addresses for warranty issues.

B. SHOP DRAWINGS ON ITEMS REQUIRING PERFORMANCE AFFIDAVITS WILL NOT BE REVIEWED UNTIL ACCEPTABLE PERFORMANCE AFFIDAVITS ARE RECEIVED.

1.05 OPERATION AND MAINTENANCE INSTRUCTION/MANUALS

A. Operation and Maintenance (O&M) manuals shall be submitted in accordance with Section 01300, Submittals.

1.06 GENERAL INFORMATION AND DESCRIPTION

A. All parts of the equipment furnished shall, be designed and constructed for the maximum stresses occurring during fabrication, transportation, installation, testing, and all conditions of operation. All materials shall be new, and both workmanship and materials shall be entirely suitable for the service to which the units are to be subjected and shall conform to all applicable sections of these Specifications.

B. All parts of duplicate equipment shall be interchangeable without modification. Manufacturer's design shall accommodate all the requirements of these Specifications.

C. Equipment and appurtenances shall be designed in conformity with ASTM, ASME, AIEE, NEMA, and other generally accepted applicable standards.

D. All bearings and moving parts shall be adequately protected by bushings or other approved means against wear, and provision shall be made for accessible lubrication by extending lubrication lines and fittings to approximately 30 inches above finished floor elevation.

E. Details shall be designed for appearance as well as utility. Protruding members, joints, corners, gear covers, etc., shall be finished in appearance. All exposed welds on machinery shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.

F. Machinery parts shall conform within allowable tolerances to the dimensions shown on the working drawings.

G. All machinery and equipment shall be safeguarded in accordance with the safety codes of the USA and the State in which the project is located.

H. All rotating shafts, couplings, or other moving pieces of equipment shall be provided with suitable protective guards of sheet metal or wire mesh, neatly and rigidly supported. Guards shall be removable as required to provide access for repairs.

I. All equipment greater than 100 pounds shall have lifting lugs, eyebolts, etc., for ease of lifting, without damage or undue stress exerted on its components.

J. All manufactured items provided under this Section shall be new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products.

1.07 EQUIPMENT WARRANTIES

A. Warranty requirements may be added to or modified in the individual equipment specifications.

B. The equipment furnished under this Contract shall be guaranteed to be free from defects in workmanship, design and/or materials for a period of one (1) year unless otherwise specified in the individual equipment specifications. The period of such warranties shall start on the date the particular equipment is placed in use by the County with corresponding start-up certification provided by the manufacturer's technical representative as specified herein, provided that the equipment demonstrates satisfactory performance during the thirty day operational period after the equipment startup. If the equipment does not perform satisfactorily during the thirty day operational period, the start of the warranty period will be delayed until the equipment demonstrates proper operation. The Equipment Supplier shall repair or replace without charge to the County any part of equipment which is defective or showing undue wear within the guarantee period, or replace the equipment with new equipment if the mechanical performance is unsatisfactory; furnishing all parts, materials, labor, etc., necessary to return the equipment to its specified performance level. Repairs made during the warranty period shall include any required re-balancing.

C. The Contractor shall provide an equipment warranty log book prepared specifically for this project and submit two (2) copies of the document to the Engineer prior to final payment. The equipment warranty log book shall include a summary listing of all equipment warranties provided, date received, and start date and end date of warranty period. A copy of each equipment warranty and equipment start-up certification shall also be provided in the document.

D. The Equipment Supplier shall guarantee to the County that all equipment offered under these specifications, or that any process resulting from the use of such equipment in the manner stated is not the subject of patent litigation, and that he has not knowingly offered equipment, the installation or use of which is likely to result in a patent controversy, in which the County as user is likely to be made the defendant.

E. Where patent infringements are likely to occur, each Equipment Supplier shall submit, as a part of his bid, license arrangements between himself, or the manufacturer of the equipment offered, and the patent County or the controller of the patent, which will permit the use in the specified manner of such mechanical equipment as he may be bidding.

F. Each Equipment Supplier, by submitting his bid, agrees to hold and save the County and Engineer or its officers, agents, servants, and employees harmless from liability of any nature or kind, including cost and expenses for, or on account of, any patented or unpatented invention, process, article, or appliance manufactured or used in the performance of the work under this contract, including the use of the same by the County.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The materials covered by these Specifications are intended to be equipment of proven reliability, and as manufactured by reputable manufacturers having experience in the production of such equipment. The Contractor shall, upon request of the Engineer, furnish the names of not less than 5 successful installations of the manufacturer's equipment of the same size and model of that offered under this contract. The equipment furnished shall be designed, constructed, and installed in accordance with the industry accepted practices and shall operate satisfactorily when installed as shown on the Drawings and operated per manufacturer's recommendations.

2.02 ANCHORS AND SUPPORTS

A. The Contractor shall furnish, install, and protect all necessary guides, bearing plates, anchor and attachment bolts, and all other appurtenances required for the installation of the devices included in the equipment specified. Working Drawings for installation shall be furnished by the equipment manufacturer, and suitable templates shall be used by the Contractor when required in the detailed equipment Specifications.

B. Anchor bolts and fasteners shall be furnished in accordance with Section 05050, Metal Fastening, and with the individual equipment Specifications. All anchor bolts shall be a minimum of 1/2-inch diameter. All anchor bolts, handrail bolts, washers, clips, clamps, and fasteners of any type shall be constructed of 316 stainless steel, unless otherwise specified in the individual equipment Specifications.

C. The Contractor shall provide all concrete pads or pedestals required for equipment furnished. All concrete equipment pads shall be a minimum of 6” high, unless otherwise shown on the Drawings and shall be doweled.

D. Pipe sleeves or other means of adjusting anchor bolts shall be provided where indicated or required. Equipment shall be leveled by first using sitting nuts on the anchor bolts, and then filling the space between the equipment base and concrete pedestal with non-shrink grout, unless alternate methods are recommended by the manufacturer and are acceptable to the Engineer (such as shim leveling pumps, or chemical grout). Non-shrink grout shall be as specified in Section 03315 - Grout.

2.03 STRUCTURAL STEEL

A. Structural steel used for fabricating equipment shall conform to the requirements of Section 05120, Structural Steel.

B. All materials shall conform to applicable provisions of the AISC Specifications for the design and fabrication of structural steel, and to pertinent ASTM Standard Specifications.

2.04 DISSIMILAR METALS

A. All dissimilar metals shall be properly isolated to the satisfaction of the Engineer.

2.05 GALVANIZING

A. Where required by the equipment specifications, galvanizing shall be performed in accordance with Section 05035, Galvanizing.

2.06 STANDARDIZATION OF GREASE FITTINGS

A. The grease fittings on all mechanical equipment shall be such that they can be serviced with a single type of grease gun. Fittings shall be “Zerk” type.

2.07 ELECTRICAL REQUIREMENTS

A. All electrical equipment and appurtenances, including but not limited to motors, panels, conduit and wiring, etc., specified in the equipment specifications shall comply with the applicable requirements of the Division 16 specifications and the latest National Electric Code.

B. In the individual equipment specifications, specified motor horsepower is intended to be the minimum size motor to be provided. If a larger motor is required to meet the specified operating conditions and performance requirements, the Contractor shall furnish the larger sized motor and shall upgrade the electrical service (conduit, wires, starters, etc.) at no additional cost to the County.

C. Where variable frequency drives (VFDs) are specified, the Contractor shall be responsible for coordinating between equipment supplier and VFD supplier to ensure a complete and operational system. VFDs shall be furnished under Division 16 and shall be as specified in Section 16165, Variable Frequency Drives.

D. Motor starters and controls shall be furnished and installed under Division 16 and Division 17 unless otherwise specified in the individual pump specifications.

2.08 ACCESSORIES, SPARE PARTS, AND SPECIAL TOOLS

A. Spare parts for equipment shall be furnished where indicated in the equipment Specifications or where recommended by the equipment manufacturer.

B. Spare parts shall be identical and interchangeable with original parts.

C. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

D. Painting requirements for spare parts shall be identical to those for original, installed parts. Where no painting or protective coating is specified, suitable provisions shall be made to protect against corrosion.

E. Spare parts shall be delivered at the same time as the equipment to which they pertain. Spare parts shall be stored separately in a locked area, maintained by the Contractor, and shall be turned over to the County in a group prior to substantial completion. All of these materials shall be properly packed, labeled, and stored where directed by the County and Engineer.

F. The Contractor shall furnish all special tools necessary to operate, disassemble, service, repair, and adjust the equipment in accordance with the manufacturers operation and maintenance manual.

G. The Contractor shall furnish a one year supply of all recommended lubricating oils and greases. The manufacturer shall submit a list of at least four manufacturer's standard lubricants which may be used interchangeably for each type of lubricant required. All of these materials shall be properly packed, labeled and stored where directed by the Engineer.

2.09 EQUIPMENT IDENTIFICATION

A. All mechanical equipment shall be provided with a substantial stainless steel nameplate, mechanically fastened with stainless steel hardware in a conspicuous place, and clearly inscribed with the manufacturer's name, year of manufacture, serial number, and principal rating data.

B. All equipment provided under Divisions 11 through 15 including motorized and manual gates and valves (aboveground and buried) shall also be identified as to the equipment name and equipment tag number by a suitable laminated plastic or stainless steel nameplate mechanically fastened with stainless steel hardware; for example, "Primary Sludge Gravity Thickener Overflow Pump No. 1: #51-P-301". Equipment names and equipment tag numbers shall match the names provided for the equipment as identified on the Drawings and in the Specifications. Equipment names and tag numbers not currently identified in the Drawings and Specifications shall be provided to the Contractor prior to the fabrication of the nameplates. Coordinate name and number with same on remotely located controls, control panel, and other related equipment. For buried valve applications, the valve name and number shall be included in the bronze disc embedded in the valve’s concrete collar as identified on the Drawings.

C. Nameplates shall not be painted over.

PART 3 -- EXECUTION

3.01 SHOP TESTING

A. All equipment shall be tested in the shop of the manufacturer in a manner which shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents and that it will operate in the manner specified or implied.

B. No equipment shall be shipped to the project until the Engineer has been furnished a certified copy of test results and has notified the Contractor, in writing, that the results of such tests are acceptable.

C. Five (5) certified copies of the manufacturer's actual test data and interpreted results thereof shall be forwarded to the Engineer for review.

D. If required by the individual equipment Specifications, arrangements shall be made for the County/Engineer to witness performance tests in the manufacturer's shop. The Engineer shall be notified ten working days before shop testing commences.

E. Shop testing of electric motors shall be in accordance with applicable requirements of individual equipment specifications and Section 16035, Acceptance Testing and Performance Verification.

3.02 STORAGE OF EQUIPMENT AND MATERIALS

A. Contractor shall store his equipment and materials at the job site in strict accordance with the manufacturer's recommendations and as directed by the County or Engineer, and in conformity to applicable statutes, ordinances, regulations, and rulings of the public authority having jurisdiction. Equipment and materials shall not be delivered to the site prior to 90 days in advance of the scheduled installation. Partial payment requests will not be processed for materials delivered prior to 90 days before installation or for materials that are not properly stored.

B. Material or equipment stored on the job site is stored at the Contractor's risk. Any damage sustained of whatever nature shall be repaired to the Engineer's satisfaction at no expense to the County. Stored electrical equipment is to be protected from the elements and shall have space heaters energized.

C. Contractor shall not store unnecessary materials or equipment on the job site and shall take care to prevent any structure from being loaded with a weight which will endanger its security or the safety of persons.

D. Contractor shall observe all regulatory signs for loadings on structures, fire safety, and smoking areas.

E. Contractor shall not store materials or encroach upon private property without the written consent of the owner of such private property.

3.03 MANUFACTURER’S FIELD SERVICES

A. The Contractor shall arrange for a qualified Technical Representative from each manufacturer or supplier of equipment who is regularly involved in the inspection, installation, start-up, troubleshooting, testing, maintenance, and operation of the specified equipment. Qualification of the Technical Representative shall be appropriate to the type of equipment furnished and subject to the approval of the Engineer and the County. Where equipment furnished has significant process complexity, furnish the services of engineering personnel knowledgeable in the process involved and the function of the equipment. When necessary, the Contractor shall schedule multiple Technical Representatives to be present at the same time for the purpose of coordinating the operation of multiple pieces of related equipment.

B. For each site visit, the Technical Representative shall submit jointly to the County, the Engineer, and the Contractor a complete signed report of the results of his inspection,

operation, adjustments, and testing. The report shall include detailed descriptions of the points inspected, tests and adjustments made, quantitative results obtained if such are specified.

C. The manufacturer's Technical Representative shall provide the following services.

1. Installation: The Technical Representative shall inspect the installed equipment to verify that installation is in accordance with the manufacturer's requirements. Where required by individual equipment specifications, the Technical Representative shall also supervise the installation of the equipment.

2. Testing: After installation of the equipment has been completed and the equipment is presumably ready for operation, but before it is operated by others, the Technical Representative shall inspect, operate, test, and adjust the equipment as required to prove that the equipment is in proper condition for satisfactory operation under the conditions specified. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for startup and that nothing in the installation will render the manufacturer's warranty null and void. The report shall include date of final acceptance field test, as well as a listing of all persons present during tests.

3. Startup: The Technical Representative shall start up the equipment for actual service with the help of the Contractor. In the event that equipment or installation problems are experienced, the Contractor and the representative shall provide the necessary services until the equipment is operating satisfactorily and performing according to the specifications at no additional cost to the County. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void.

4. Training: The Technical Representative shall instruct the County's operating personnel in correct operation and maintenance procedures. The instruction shall demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment. Such instruction shall be scheduled at a time arranged with the County at least 2 weeks in advance of the training and shall be provided while the respective Technical Representative's equipment is fully operational. The Contractor shall have submitted, and had accepted, the O&M Manuals prior to commencement of training. Training shall be provided to four separate shifts of the County's personnel between the hours of 6:00 A.M. and 6:00 P.M. as necessary. The Contractor shall provide professional video recordings of all training sessions. Completed, labeled recordings shall be provided to the County for each type of training session.

5. Services after Startup: Where required by the individual equipment specifications, the Technical Representative shall return to the project site one hundred and eighty (180) days after the start-up date to review the equipment performance, correct any equipment problems, and conduct operation and maintenance classes as required by the County. This follow-up trip is required in addition to the specified services of Technical Representative prior to and during equipment startup. At this time, if there are no equipment problems, each manufacturer shall certify to the County in writing

that his equipment is fully operational and capable of meeting operating requirements. If the equipment is operating incorrectly, the Technical Representative will make no certification to the County until the problems are corrected and the equipment demonstrates a successful thirty (30) days operating period.

D. Services of the Technical Representative will require a minimum of two (2) site visits, one for installation and testing and one for startup and training, and will be for the minimum number of days recommended by the manufacturer and approved by the Engineer but will not be less than the number of days specified in individual equipment sections.

E. The Contract amount shall include the cost of furnishing the Technical Representative for the minimum number of days specified, and any additional time required to achieve successful installation and operation. The times specified for services by the Technical Representative in the equipment Specifications are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.

F. The Contractor shall notify the Engineer at least 14 days in advance of each equipment test or County training session.

G. The Technical Representative shall sign in and out at the office of the Engineer's Resident Project Representative on each day he is at the project.

3.04 INSTALLATION

A. The Contractor shall obtain written installation manuals from the equipment manufacturer prior to installation. Equipment shall be installed strictly in accordance with recommendations of the manufacturer. A copy of all installation instructions shall be furnished the Engineer's field representative one week prior to installation.

B. The Contractor shall have on hand sufficient personnel, proper construction equipment, and machinery of ample capacity to facilitate the work and to handle all emergencies normally encountered in work of this character. To minimize field erection problems, mechanical units shall be factory-assembled insofar as practical.

C. Equipment shall be erected in a neat and workmanlike manner on the foundations at the locations and elevations shown on the Drawings.

D. All equipment sections and loose items shall be match-marked prior to shipping.

E. For equipment such as pumping units, which require field alignment and connections, the Contractor shall provide the services of the manufacturer's qualified mechanic, millwright, or machinist, to align the pump and motor prior to making piping connections or anchoring the pump base. Alignment shall be as specified herein.

F. The Contractor shall furnish oil and grease for initial operation and testing. The manufacturer and grades of oil and grease shall be in accordance with the recommendations of the equipment manufacturer.

3.05 ALIGNMENT

A. Set equipment to dimensions shown on drawings. Dimensions shall be accurate to +/- 1/16 inch unless otherwise noted on the drawings. Wedges shall not be used for leveling, aligning, or supporting equipment.

B. General Equipment Leveling: Non-rotating equipment shall be set level to +/- 1/16 inch per 10 foot length (.005 inch per foot) unless otherwise noted on the drawings. Shims shall be used unless equipment is furnished with leveling feet. Set shims flush with equipment baseplate edges. When grouting is required, equipment shall be shimmed to allow a minimum of one inch grout thickness. Grout shall cover shims at least 3 inches. Final level check shall be held for inspection and approval by Engineer before proceeding.

C. Grouting

1. Fill anchor bolt holes or sleeves with grout, after bolt alignment is proven, and prior to placing grout under equipment bases.

2. Surface Preparation. Roughen surface by chipping, removing laitance, and unsound concrete. Clean area of all foreign material such as oil, grease, and scale. Saturate area with water at least 4 hours prior to grouting, removing excess water ponds.

3. Application. Place grout after the equipment base has been set and its alignment and level have been approved. Form around the base, mix grout, and place in accordance with the grout manufacturers published instructions. Eliminate all air or water pockets beneath the base using a drag chain or rope.

4. Finishing. Point the edges of the grout to form a smooth 45 degree slope.

5. After grout has cured (not before 3 days after placement) paint exposed surfaces of grout with shellac.

6. Level Verification. After grout has cured, and immediately prior to drive alignment, recheck equipment for level and plumb. Re-level and square as necessary. Hold final checks for inspection and approval by Engineer.

D. Inspect for and remove all machining burrs or thread pulls in female holes on mating surfaces of mounting frame and machine feet.

E. Inspect and clean equipment mounting base pads, feet, and frames to remove all grease, rust, paint and dirt.

F. Assembled equipment shafts shall be set level to .0015 inches per foot of shaft length (+/- .0005 inches) up to a maximum of 0.015 inches for any length shaft unless the manufacturer's requirements are more stringent or unless otherwise noted in the equipment specifications. Use the machined surfaces on which the equipment sets for the base/mounting frame leveling plane. Use the machined shaft surface for equipment leveling plane.

G. Sprocket and Sheave Alignment. Check shaft mounted components for face runout and eccentricity (outside diameter) runout by magnetically mounting a dial indicator on a stationary base and indicating over 360 degrees on a continuous machined surface at the outside diameter of the component. Maximum allowable total indicated face runout and eccentricity for sprockets and sheaves will be per ANSI Standard B29.1-1975.

H. Belt tensioning. Set drive belt tension to manufacturer's specification for the belt type. Recheck alignment after drive tensioning.

I. Thermal/Mechanical Growth. Thermal/mechanical growth corrections for driver and driven machines will be used in vertical and horizontal alignment where applicable. The equipment manufacturer will determine thermal/mechanical growth applicability for any machine and provide the correction offsets to be used.

J. Rotating Shaft Alignment

1. Fixtures will be set up on the driver and driven machine, machines shaft surfaces. Machined coupling hubs may be used only if there is no clearance to mount fixtures directly on the shafts.

2. Primary alignment method for direct drive machines is when coupled. Uncoupled alignment will be used only when approved by the Engineer.

3. Account for possible coupling flex by always rotating coupled machines in the same direction during alignment.

4. Uncoupled machines must be connected so that both shafts turn together without relative motion during alignment.

5. Indicator bar sag will be measured and included for each reverse indicator alignment setup.

6. Reverse Dial Indicator. The final maximum allowable misalignment: vertical and horizontal from the desired targets of .000 inches (for a non-thermal growth machine) or from the given target readings (for a thermal growth machine) must meet BOTH of the following conditions simultaneously: 1/2 the final total indicator reading at each indicator will be no more than shown in the table below AND the final remaining correction at each machine foot be no more than .001 inches of required movement.

Machine Speed (RPM)	**Total Misalignment* (inches)**
Up to 1800	.002
1800 and greater	.001

**1/2 indicator reading*

3.06 FIELD TESTING

A. All equipment shall be set, aligned and assembled in conformance with the manufacturer's drawings and instructions. Provide all necessary calibrated instruments to execute performance tests. Submit report certified by the pump manufacturer’s representative.

B. Preliminary Field Tests, Yellow Tag

1. As soon as conditions permit, after the equipment has been secured in its permanent position, the Contractor shall:

   a. Verify that the equipment is free from defects.

   b. Check for alignment as specified herein.

   c. Check for direction of rotation.

   d. Check motor for no load current draw.

2. Contractor shall flush all bearings, gear housings, etc., in accordance with the manufacturer's recommendations, to remove any foreign matter accumulated during shipment, storage or erection. Lubricants shall be added as required by the manufacturer's instructions.

3. When the Contractor has demonstrated to the Engineer that the equipment is ready for operation, a yellow tag will be issued. The tag will be signed by the Engineer, or his assigned representative and attached to the equipment. The tag shall not be removed.

4. Preliminary field tests, yellow tag, must be completed before equipment is subjected to final field tests, blue tag.

C. Final Field Tests, Blue Tag

1. Upon completion of the above, and at a time approved by the Engineer, the equipment will be tested by operating it as a unit with all related piping, ducting, electrical and controls, and other ancillary facilities.

2. The equipment will be placed in continuous operation as prescribed or required and witnessed by the Engineer or his assigned representative and the County or his assigned representative.

3. The tests shall prove that the equipment and appurtenances are properly installed, meet their operating cycles and are free from defects such as overheating, overloading, and undue vibration and noise. Operating field tests shall consist of the following:

   a. Check equipment for excessive vibration and noise as specified herein.

   b. Check motor current draw under load conditions. The rated motor nameplate current shall not be exceeded.

   c. Recheck alignment with dial indicators where applicable, after unit has run under load for a minimum of 24 hours.

D. In addition to the above described field tests, any other tests specifically required by Section 11100, Pumps-General, the individual equipment Specifications, or by the manufacturer shall be performed.

E. Until final field tests are acceptable to the Engineer, the Contractor shall make all necessary changes, readjustments and replacements at no additional cost to the County.

F. Upon acceptance of the field tests, a blue tag will be issued. The tag will be signed by the Engineer and attached to the unit. The tag shall not be removed and no further construction work will be performed on the unit, except as required during start-up operations and directed by the Engineer.

G. Defects which cannot be corrected by installation adjustments will be sufficient grounds for rejection of any equipment.

H. All costs in connection with field testing of equipment such as lubricants, temporary instruments, labor, equipment, etc., shall be borne by the Contractor. Power, fuel, chemicals, water, etc. normally consumed by specific equipment shall be supplied by the County unless otherwise specified in the individual equipment specifications.

I. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the County formally takes over the operation thereof.

J. Field testing of electric motors shall be in accordance with individual equipment specifications and Section 16035, Acceptance Testing and Performance Verification.

3.07 VIBRATION TESTING

A. Unless specified otherwise in the detailed equipment specifications, each pump, blower, compressor, motor, or similar item of stationary rotating equipment having a rated power in excess of 40HP shall be tested after installation for acceptable vibration levels.

B. Vibration testing shall be performed by an experienced factory-trained and authorized third-party analysis expert (not a sales representative) retained by the Contractor and approved by the Engineer. Each unit or pump system shall be tested separately without duplicate equipment running. All field testing shall be done in the presence of the Engineer. The Engineer shall be furnished with four (4) certified copies of vibration test data for each test performed.

C. For systems with variable speed drives, tests shall be conducted at various speeds between maximum and minimum. For systems with two-speed drives, tests shall be conducted at both speeds. For systems with constant-speed drive, tests shall be conducted under various loading conditions as determined by the Engineer.

D. All field vibration tests shall be performed with the equipment operating on the product for which it is intended, or a substitute acceptable to the Engineer.

E. The term displacement, as used herein, shall mean total peak-to-peak movement of vibrating equipment, in mils; velocity or speed of the vibration cycle, measured in G's.

Displacement and velocity shall be measured by suitable equipment equal to IRD Mechanalysis, Bentley, Nevada.

E. Frequency of vibration, in cycles per minute (cpm), shall be determined when vibration exceeds specified levels or as otherwise necessary. Vibration shall be measured on the bearing housing, unless other locations are deemed necessary by the vibration analysis expert and Engineer.

F. For all equipment tested, vibration shall be checked in the radial and axial directions. Unless otherwise specified elsewhere, axial vibration shall not exceed 0.1 in/sec; and radial vibration shall not exceed 0.2 in/sec. For pumps radial vibration shall not exceed that permitted by the Hydraulic Institute Standards except that, at vibration frequencies in excess of 8,000 cpm, the velocity shall not exceed 0.2 in/sec.

G. Copies of test results shall be submitted to the Engineer for review. Should the vibration field test results exceed shop test results, the manufacturer's recommendations, or the limits specified herein, the Contractor shall correct the deficiencies within thirty (30) days. After corrections have been completed, the vibration testing shall be re-run and the results re-submitted to the Engineer for review.

H. Noise or vibration in any rotating equipment which the Engineer determines to be excessive or damaging and falls outside of the acceptable limits for that particular piece of equipment, shall be cause for rejection.

3.08 FAILURE OF EQUIPMENT TO PERFORM

A. Any defects in the equipment or failure to meet the guarantees or performance requirements of the Specifications shall be promptly corrected by the Contractor by replacements or otherwise.

B. If the Contractor fails to make these corrections, or if the improved equipment shall fail again to meet the guarantees or specified requirements, the County, notwithstanding his having made partial payment for work and materials which have entered into the manufacture of said equipment, may reject said equipment and order the Contractor to remove it from the premises at the Contractor's expense.

C. The Contractor shall then obtain specified equipment to meet the contract requirements or upon mutual agreement with the County, adjust the contract price to reflect not supplying the specific equipment item.

D. In case the County rejects said equipment, then the Contractor hereby agrees to repay to the County all sums of money paid to him for said rejected equipment on progress certificates or otherwise on account of the lump sum prices herein specified.

E. Upon receipt of said sums of money, the County will execute and deliver to the Contractor a bill of sale of all his rights, title, and interest in and to said rejected equipment; provided, however, that said equipment shall not be removed from the premises until the County obtains from other sources other equipment to take the place of that rejected.

F. Said bill of sale shall not abrogate County's right to recover damages for delays, losses, or other conditions arising out of the basic contract.

3.09 PAINTING

A. All surface preparation, shop painting, field repairs, finish painting, and other pertinent detailed painting specifications shall conform to applicable sections of Section 09900, Painting.

B. All shop coatings shall be compatible with proposed field coatings.

C. All inaccessible surfaces of the equipment, which normally require painting, shall be finished painted by the manufacturer. The equipment and motor shall be painted with a high quality epoxy polyamide semi-gloss coating specifically resistant to chemical, solvent, moisture, and acid environmental conditions, unless otherwise specified.

D. Gears, bearing surfaces, and other unpainted surfaces shall be protected prior to shipment by a heavy covering of rust-preventive compound sprayed or hand applied which shall be maintained until the equipment is placed in operation. This coating shall be easily removable by a solvent.

3.10 WELDING

A. The Equipment Manufacturer's shop welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirement of AWS D1.1 "Structural Welding Code - Steel" or AWS D1.2 "Structural Welding Code - Aluminum" of the American Welding Society, as applicable.

B. The Contractor's welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirements of AWS D1.1 "Structural Welding Code - Steel" or AWS D1.2 "Structural Welding Code - Aluminum" of the American Welding Society, as applicable.

C. The Contractor shall perform all field welding in conformance with the information shown on the Equipment Manufacturer's drawings regarding location, type, size, and length of all welds in accordance with "Standard Welding Symbols" AWS A2.0 of the American Welding Society, and special conditions, as shown by notes and details.

- END OF SECTION -

SECTION 11100

PUMPS - GENERAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, test, and make fully operational all pumping equipment, complete with all necessary accessories, in compliance with the Contract Documents.

B. All pumping equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions.

C. The provisions of this section shall apply to all pumps and pumping equipment specified except where specifically noted otherwise in the Contract Documents.

D. The pumps shall be provided complete with all accessories, shims, sheaves, couplings, and other appurtenances as specified, and as may be required for a complete and operating installation.

1.02 SHOP DRAWINGS

A. Shop Drawings shall include the following information in addition to the requirements of Section 01300, Submittals and Section 11000, Equipment General Provisions.

1. Details of shaft sealing system

2. Pump performance curves at rated speed and reduced speed (if reduced speeds are specified). Curves shall indicate flow, head, efficiency, brake horsepower, NPSH required, and minimum submergence. Curves shall include limits (minimum and maximum flows) for stable operation without cavitation, overheating, recirculation, or excessive vibration.

3. General cutaway sections, materials, dimension of shaft projections, shaft and keyway dimensions, shaft diameter, dimension between bearings, general dimensions of pump, suction head bolt orientation, and anchor bolt locations and forces.

4. Foundry certificates and results of Brinnell hardness testing showing compliance to ASTM A 532 (where required in the individual pump specifications).

5. Submersible pump submittals shall also include:

a. Product data sheets for power and control cables and length of cables.

b. Details on pump guide rail system and mounting requirements.

PART 2 -- PRODUCTS

2.01 MATERIALS

A. All materials employed in the pumping equipment shall be suitable for the intended application. Material not specifically called for shall be high-grade, standard commercial quality, free from all defects and imperfection that might affect the serviceability of the product for the purpose for which it is intended, and shall conform to the following requirements unless otherwise specified in individual pumping equipment Specifications:

1. Cast iron pump casings and bowls shall be of close-grained gray cast iron, conforming to ASTM A 48, or equal.

2. Bronze pump impellers shall conform to ASTM B 584, “G” bronze.

3. Stainless steel pump shafts shall be of Type 400, Series. Miscellaneous stainless steel parts shall be of Type 316.

B. Suction and discharge flanges shall conform to ANSI standard B16.1 or B16.5 dimensions.

C. Handholes on pump casings shall be shaped to follow the contours of the casing to avoid any obstructions in the water passage.

2.02 APPURTENANCES

A. Pressure Gauges

1. The Contractor shall furnish and install pressure gauges on the suction and discharge of each pump.

2. All gauges shall be provided with diaphragm seals or isolating ring seals as specified in Division 17.

B. Flexible couplings for direct driven pumps shall be as manufactured by Falk, Dodge, Woods Corp., or equal, and shall be furnished with guards in accordance with OSHA Rules and Regulations. Spacer couplings shall be provided where necessary to allow removal of the pump rotating element without disturbing the driver.

2.03 ELECTRICAL REQUIREMENTS

A. All pumps shall be furnished with motors such that the motor shall not be overloaded throughout the full range of the pump operation, unless otherwise specifically approved by the Engineer.

B. Where variable frequency drives (VFDs) are specified, the Contractor shall be responsible for coordinating between pump supplier and VFD supplier to ensure a complete and operational system. VFDs shall be furnished under Division 16 and shall be as specified in Section 16165, Variable Frequency Drives.

C. Motor starters and controls shall be furnished and installed under Division 16 and Division 17 unless otherwise specified in the individual pump specifications.

2.04 EQUIPMENT IDENTIFICATION

A. In addition to the requirements of Section 11000, Equipment General Provisions, nameplate data for each pump shall include the rating in gallons per minute, rated head, speed, and efficiency at the primary design point.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Drains: All gland seals, air valves, and drains shall be piped to the nearest floor drain or trench drain with galvanized steel pipe or copper tube, properly supported with brackets.

B. Solenoid Valves: Where required, the pump manufacturer shall furnish and install solenoid valves on the water or oil lubrication lines. Solenoid valve electrical rating shall be compatible with the motor control voltage and shall be furnished complete with all necessary conduit and wiring installation from control panel to solenoid.

3.02 SHOP TESTING

A. Shop tests shall be performed in accordance with Section 11000, Equipment General Provisions, and except where stated otherwise herein, shall be conducted in accordance with applicable methods and standards of the American National Standard for Centrifugal Pump Tests by the Hydraulic Institute, or American National Standard for Vertical Pump Tests by the Hydraulic Institute for Vertical Pumps.

B. Pump testing shall be witnessed by the County/Engineer where specified in the individual pump specifications. The testing procedure shall be submitted to the Engineer for review before scheduling the testing. The Engineer shall be given at least 2 weeks advanced notice of the scheduled testing date.

C. Certified test curves shall be provided for all centrifugal pumps unless otherwise specified in the individual pump specifications. Certified tests will not be required for submersible sump pumps with motors less than 5 hp.

D. Pumps shall be within the tolerances specified by the Hydraulic Institute Standards with the following exceptions:

1. At design heads, +10% of design capacities or at design capacities, +5% of design heads.

2. No minus tolerances shall be allowed with respect to capacity, head, or efficiency at the design points.

E. For wet pit submersible pumps and vertical turbine pumps, all tests shall be run at minimum pump submergence specified in the individual pump specifications.

F. Where required in the individual pump specifications, each individual casting shall be Brinnell tested in a minimum of two places, in an area of representative casting thickness to ASTM Method E-10. Results shall be certified by a registered Professional Engineer. Test results shall verify the satisfaction of the required Brinnell hardness of the finished product as specified in respective subsections.

3.03 FIELD TESTING

A. Field tests shall be performed in accordance with in Section 11000, Equipment General Provisions and additionally as specified below and in the individual pump specifications.

B. Final acceptance tests shall demonstrate the following:

1. The pumps have been properly installed and are in proper alignment.

2. The pumps operate without overheating or overloading of any parts and without objectionable vibration. Vibration shall be within the Hydraulic Institute limits, or manufacturer's limits if more stringent.

3. The pumps can meet the specified operating conditions. All pumps shall be checked at maximum speed for a minimum of four points on the pump curve for capacity, head, and amperage. The rated motor nameplate current shall not be exceeded at any point. Pumps with drive motors rated at less than five horsepower shall only be tested for overcurrent when overheating or other malfunction becomes evident in general testing.

- END OF SECTION -

SECTION 11130

SUBMERSIBLE NON-CLOG PUMPS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install submersible non-clog wastewater pumps with enclosed, submersible electric motors and all appurtenant work, complete and operable, all in accordance with the Contract documents and as specified herein.

B. Pump Size: The new pumps are being installed in an existing wetwell. The new pumps shall have physical dimensions such that no modifications are required to the existing concrete wetwell or access hatch to allow for removal or access of the new pumps. The size of the new pumps shall also not have any impact on the hydraulic conditions in the wetwell. The interior dimensions of the access hatch are approximately 28” by 47”. Contractor shall verify dimensions and potential impacts from the proposed pumps during the bidding phase. The cost of any improvements to the lift station due to the selection of the proposed pump, outside of what is shown in the contract documents, shall be borne by the Contractor.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 11000 – Equipment General Provisions

B. Section 11100 – Pumps, General

C. Division 16 – Electrical

D. Division 17 – Instrumentation

1.03 SUBMITTALS

A. The Contractor shall comply with all submittal requirements specified in the Section entitled “Pumps, General”.

B. Contractor shall submit a layout drawing of the new pumps inside the existing wetwell and provide verification from the pump supplier that the size of the new pumps will not create any hydraulic/performance issues and that they will not require modifications to the existing wetwell and/or access hatch to allow for access and removal.

1.04 QUALITY ASSURANCE

A. The Contractor shall comply with all quality assurance requirements specified in Section 11100, entitled “Pumps, General”.

1.05 MANUFACTURER'S SERVICE REPRESENTATIVE

A. The Contractor shall provide the services of a manufacturer's service representative as specified in Section 11100, Pumps, General.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The pumps shall be as manufactured by Sulzer ABS Model XFP 100E or Flygt Model NP 3153.

B. All pumps shall be designed for intermittent operation but rated for continuous operation and shall be suitable for pumping thickened waste activated sludge, digested sludge, aerobic digester decant, dewatering centrifuge centrate, centrifuge slops, and dewatering building washdown drains.

2.02 PUMP CONSTRUCTION

A. Submersible non-clog pumps shall conform to the requirements and conditions listed herein.

B. Major pump components shall be of grey cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts or bolts shall be AISI type 304 stainless steel construction. All exterior metal surfaces coming into contact with the pumped material, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate and a polyester resin enamel finish.

C. All O-rings shall be of Nitrile rubber.

D. The lifting handle shall be stainless steel.

E. Cooling System: Motors shall be sufficiently cooled by the surrounding environment or pumped media so that a water cooling jacket is not required.

F. Mechanical Seal: Each pump shall be provided with a tandem mechanical shaft seal system consisting of two (upper and lower) totally independent seal assemblies. The seals shall operate in a lubricant reservoir that hydro-dynamically lubricates the lapped seal faces at a constant rate. The upper and lower primary seals shall be corrosion resistant silicone-carbide/silicone-carbide. The upper seal shall be carbon/ceramic. Seals shall require neither maintenance nor adjustment.

G. Impellers: The Impeller shall be of gray cast iron, dynamically balanced, single vane design and sprayed with primer.

H. Volute: The pump volute shall be single-piece grey cast iron, Class 35B, non-concentric design with smooth passages large enough to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified below.

I. Bearings: The upper bearing shall be a single row ball bearing. The lower bearing shall be a two row angular contact ball bearing. Motor bearings shall be permanently grease lubricated.

J. Self Cleaning Wear Plate: The wear plate shall be constructed from gray cast iron. The wear plate shall be designed with an inlet incorporating strategically placed cutting grooves and an outward spiral V-shaped groove on the side facing the impeller, to shred and force stringy solids outward from the impeller and through the pump discharge. The wear plate shall be mounted to the volute with four stainless steel securing screws and four stainless steel adjusting screws to permit close tolerance adjustment between the wear plate and impeller for maximum pump efficiency. Adjustment to allow for wear and restore peak pumping performance shall be accomplished using standard tools, and without requiring disassembly of the pump. The use of fixed or non-adjustable wear plates or rings, or systems that require disassembly of the pump or shimming of the impeller to facilitate adjustment shall not be considered equal. The suction flange shall be integrated into the wear plate and its bolt holes shall be drilled and threaded to accept standard 4 inch ANSI class 125 flanged fittings.

K. Pump Mounting System: The pump shall be supplied with a mating discharge connection and shall automatically and firmly be connected to the discharge connection, guided by no less than two guide rails extending from the top of the wet well to the discharge connection. There shall be no need for personnel to enter the wet well. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. No portion of the pump shall bear directly on the sump floor. Each pump shall be fitted with a 316 stainless steel lifting chain or cable with a working load of at least 50% greater than the pump unit weight.

L. Cable Entry Seal: The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable. The assembly shall provide ease of changing the cable when necessary using the same entry seal. A junction box shall be completely sealed off from the pumped media.

M. Pump Size: The pump is being installed in an existing wetwell. The new pump shall have physical dimensions such that no modifications are required to the existing wetwell or access hatch

2.03 OPERATING CONDITIONS

A. Submersible non-clog pump operating characteristics shall be as shown in the following tables.

CENTRATE LS PUMPS

Number of Pumps	2 (one duty & one standby)
Location	Existing Centrate Lift Station Wet Well
Fluid	Centrate from dewatering aerobically digested sludge
Wetwell depth (feet)	16
Pump and Motor Arrangement	submersible
Pump Mounting	Rail Mounted
Minimum Shut-off Head (feet)	96
Operating Point No. 1	
Design Capacity (gpm)	500
Total Dynamic Head (feet)	62
Minimum Efficiency (%)	69
Operating Point No. 2	
Design Capacity (gpm)	300
Total Dynamic Head (feet)	*70*
Minimum Efficiency (%)	65
Maximum Horsepower	15
Maximum Motor Speed (rpm)	1,755
Maximum Pump Speed (rpm)	1,745
Motor Drive	Constant Speed
NPSHA	Submerged
Minimum Suction Diameter (In.)	4
Minimum Discharge Diameter (In.)	4
Solids Concentration	0.5% - 3%
Temperature of Liquid Pumped	50°F-100°F

2.04 MOTORS

A. The pump motor shall be designed for 460 volt, 60 Hertz, 3-phase electrical power. Motors shall meet the requirements of the Section 16150 - Electric Motors. The motors shall be rated for continuous duty with a minimum service factor of 1.30.

1. The pump motor shall be squirrel-cage induction type, housed in an air filled watertight chamber, NEMA B type.

2. The stator winding and stator leads shall be moisture resistant and insulated with premium grade Class H insulation rated 180 degrees Celsius. The stator shall be press fitted into the stator housing.

3. The use of bolts, pins, or other fastening devices requiring penetration of the stator housing shall not be allowed.

4. The motor shall be guaranteed for continuous un-submerged duty, capable of sustain a minimum of fifteen (15) starts per hour without overheating.

5. The motor shall be inverter duty for variable speed applications.

6. All motors shall be of nationally known manufacture and shall be housed in enclosures specifically designed for submersible pump application.

2.05 SPARE PARTS

A. Spare parts shall be provided in accordance with Section 11000, Equipment General Provisions and shall include the following for each pump:

One (1) - set of lower and upper wearing rings
One (1) - set of motor and pump bearings
One (1) - complete mechanical seal assembly (upper and lower)
Two (2) - complete set of gaskets and O-ring seals

2.06 PUMP CONTROL

A. The pump shall be connected into the existing control system at the Centrate LS.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Pumping equipment shall be installed in accordance with approved procedures submitted with the shop drawings and as specified and indicated on the Contract Drawings.

B. General installation requirements shall be as specified in Section 11100 - Pumps, General.

C. Contractor shall take all care when performing work in the existing Centrate LS to avoid damaging existing concrete, piping, electrical components, or equipment. Any damage to the existing components shall be repaired to match previous conditions and shall be at no cost to the owner.

D. The Contractor shall coordinate the shutdown of the Centrate LS with the County to allow for the installation of the new pumps.

- END OF SECTION -

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SECTION 11133

SUBMERSIBLE SUMP PUMP

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install submersible non-clog sump pumps at the locations shown on the Drawings and as specified herein. All pumps shall be supplied by the same manufacturer.

B. Equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions and Section 11100, Pumps - General.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The pumps shall be Zoeller Model 72 Submersible Dewatering Pump, or similar pump as manufactured by Hydromatic or approved equal.

2.02 POWER AND OPERATION

A. Sump pump shall be rated for installation in sumps located within the hypochlorite and future sodium bisulfite containment structures and suitable for possible submersion in stored chemical in case of a leak. In general, the sump pumps shall be used to discharge collected rain water within the containment areas.

B. Sump pump shall include an automatic float operation integral with the power cord set to operate on level as indicated in the specification table.

C. Sump pump power shall be through duplex receptacle supplied under Division 16 with the pump power cord supplied with a 120V standard three-prong plug.

D. Pump duplex receptacle shall be powered through an ON/OFF manual switch supplied under Division 16 mounted near the pump on the building column or suitable support stand.

E. Receptacle and switch shall be mounted in a common PVC enclosure supplied under Division 16 mounted 42” above finished floor.

F. Pump discharge shall be connected to a Schedule 80 PVC pipe to lift the discharged fluid up and over the containment wall to discharge 2” above a concrete splash pad placed on top of the gravel ground cover outside the structure. Supply splash pad and PVC pipe.

G. Provide elevated durable, non-corrosive ABS plastic pump stand that secures to the pump and elevates the pump 2” above sump floor.

2.03 SPECIFICATIONS

Description	**Requirement**
Horse Power	3/10
Voltage	115
Phase	Single phase
Frequency	60Hz
RPM	3400
Type	Permanent split capacitor
Insulation	Class B
Amps	3.1
Operation	Automatic (when column switch is ON)
Auto On/Off Points	7-3/8" (on) / 3-5/8" (off)
Discharge Size	1-1/2" NPT
Solids Handling	3/8" spherical solids
Cord Length	9' standard
Cord Type	UL listed, 3-wire, grounded plug
Max. Head	18 feet
Max. Flow Rate	38 GPM
Max. Operating Temp.	110° F
Cooling	Oil free
Motor Protection	Auto reset thermal overload
Motor Housing	Engineered plastic
Pump Housing	Engineered plastic
Base	Engineered plastic
Up her Bearing	Ball bearing
Lower Bearing	Ball bearing
Mechanical Seals	Carbon and ceramic
Impeller Type	Non-clogging vortex
Impeller	Engineered plastic
Hardware	Stainless steel
Motor Shaft	410 stainless steel
Gasket	Buna-N O-ring

2.04 SPARE PARTS

A. Spare parts shall be provided in accordance with Section 11000, Equipment General Provisions and shall include the following for each size pump:

Two (2) - sets of any replaceable seals and/or o-rings

Float mechanism

PART 3 -- EXECUTION

3.01 TESTS

A. Place pumps in service and test for up to three cycles supplying a source of clean water. Adjust operation and/or discharge as needed for smooth operation and non-erosion discharge.

- END OF SECTION -

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SECTION 11160

ROTARY LOBE PUMPS

PART 1 -- GENERAL

1.01 WORK INCLUDED

A. The Contractor shall furnish and install positive displacement rotary lobe pumps at the locations shown on the drawings and as specified herein. The same manufacturer shall supply all pumps provided under this Section.

B. Equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions and Section 11100, Pumps - General

1.02 PERFORMANCE REQUIREMENTS

A. Positive displacement rotary lobe pumps shall conform to the following requirements.

Number of Units Installed	2 (1 operational, 1 in-line standby)
Type	Positive Displacement – Torsional Rotary Lobe
Accepted Manufacturers	Swaby-Lobeline MR-220, Boerger BLUEline FL 776
Design Flow Rate (at 100% Speed), gpm	450
Design Differential Pressure, psig	54
Feedstock	Aerobically Digested Sludge
Feedstock Solids Concentration, %TS	0.75% to 2.0%
Max. Non-Compressible Solid, inches	2.5”
Speed Control	VFD – Variable Speed
VFD Design Operating Range	25% to 100%
Max. Pump Rotating Speed (at 100% Speed), rpm	< 300
Motor Rotating Speed (at 100% Speed), rpm	< 1,800
Maximum Suction Diameter, in	6
Maximum Discharge Diameter, in	6
Run Dry Protection System	Yes
Electrical Power Feed	460 VAC/ 3-PH / 60HZ

B. The rotary lobe pump(s) are to be specifically designed to pump thickened waste activated sludge without plugging.

C. There shall be no significant change in vibration and noise level over the entire listed range of operating conditions of the pumping system.

D. Equipment is to be designed and built for 24-hour continuous service at any and all points within the specified range of operation, without overheating, without cavitation, and without excessive vibration or strain.

1.03 SUBMITTALS

A. Shop Drawings shall be submitted in accordance with the submittal requirements specified in Section 01300, Submittals; Section 01730, Operation and Maintenance Manuals; and Section 11000, Equipment General Provisions.

1. Shop Drawings. In addition to the items specified in Section 01300, “Submittals”, furnish the following:

a. Certified pump curves indicating total head, capacity, brake horsepower, and efficiency of complete pumping unit.

b. Dimensioned installation drawings, and construction material designations by ASTM Standards.

2. Operation and Maintenance Manuals.

3. Furnish certified report prepared by manufacturer’s technical representative certifying satisfactory installation, operation and in-service placement of units.

1.04 DELIVERY, STORAGE, AND HANDLING

A. After hydrostatic or other tests, all entrapped water shall be drained prior to shipment, and proper care shall be taken to protect parts from the entrance of water during shipment, storage and handling.

B. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.

C. Un-finished iron or steel surfaces are to be protected with rust preventative compounds to prevent rust and corrosion.

D. Finished surfaces of all exposed pump openings shall be protected by wooden blanks, strongly built and securely bolted thereto.

E. Protect all parts from damage that might occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.

F. Each box or package shall be properly marked to show its net weight in addition to its contents

G. Deliver, unload and store products on site in manner that prevents damage. Use special care to prevent damage from temperature and condensation.

1.05 WARRANTY

A. Warranty shall be as specified in Section 11000, Equipment General Provisions.

PART 2 -- PRODUCTS

2.01 GENERAL CONSTRUCTION REQUIREMENTS

A. Pumps shall be variable speed, positive displacement, lobe type with two rotors mounted on overhung shafts without outboard shaft bearings.

B. Pumps shall consist of a rotor case housing the rotors and shaft seals which shall be mounted to a gear case housing the shafts, shaft bearings and timing gears.

C. Pumps shall be rigidly mounted on a structural steel base plate with speed reducer and electric motor.

D. Rotor Case

1. The rotors shall be enclosed radially by the center section of the rotor case which contains the suction and discharge ports, and axially by front and back sections. The front section shall carry the front cover and the rotor shafts shall pass through the back section and shaft seal chamber.

2. The center case section shall consist of a single casting that encloses both rotors.

3. The back case section shall be fitted with replaceable wear plate(s) and the front case shall be fitted with a replaceable wear plate or a reversible front cover.

4. The front cover shall be rigidly supported by a hinge.

5. Casings shall be grey iron castings conforming to ASTM A48 or ductile iron castings conforming to ASTM A536.

6. All rotor case fasteners shall be stainless steel or coated steel.

E. Rotors

1. Rotors shall be ductile iron castings conforming to ASTM A536 and encapsulated in a urethane elastomer having a Durometer hardness of 90.

2. Rotors shall have three or more lobes and shall be of either straight or screw rotor design. A single rotor shall be attached to each shaft and be positively secured to the end of the shaft in correct axial adjustment. The locking assembly and rotor to shaft joint shall be protected from sludge contact by O-ring seals.

a. Rotors shall be held in precise radial position on the shafts by involute splines.

F. Shafts

1. Shafts shall be manufactured of chromium-molybdenum steel conforming to SAE 4140 or chromium-nickel-molybdenum steel conforming to SAE 4340.

2. Shafts shall not be wetted by the pumped sludge.

3. Shafts shall be timed in their rotation by hardened steel spur gears to achieve non-contact, close clearance operation of the rotors and transmit power from the rotor shaft connected to the driver to the other rotor shaft.

G. Bearings

1. Antifriction bearings shall be provided on both shafts to absorb radial and thrust loads.

2. The minimum ABMA L10 bearing life under the design conditions shall be 100,000 hours.

H. Gear Case

1. The gear case shall be cast iron conforming to ASTM A48, Grade 30 or higher.

2. The gear case shall contain oil reservoir(s) for lubrication of the shaft bearings and timing gears.

3. The gear case shall be provided with oil fill and drain connections and shall have a removable cover for access to the timing gears and bearings.

I. Drive

1. A gear motor shall be provided to transmit power to the pump. The speed reducer gearbox shall have an AGMA service factor of 1.5.

2. The gear motor shall have a footmounted cast iron housing containing oil lubrication for antifriction bearings and gears. The housing shall in corporate a breather and oil fill and drain connections.

3. Gear motors shall be coupled to pumps by flexible couplings to transmit power and absorb minor misalignment. Couplings shall be of the steel grid or elastomeric sleeve type and be covered by OSHA compliant guards.

2.02 ADDITIONAL CONSTRUCTION REQUIREMENTS FOR SWABY LOBELINE PUMPS

A. Rotor Case

1. The center section of the rotor case shall be cast with integral suction and discharge nozzles with ANSI Class 125 flanges.

2. Back wear plates shall incorporate grooves or slotted rotors to prevent the accumulation of fibrous material behind the rotor.

B. Shaft seals

1. Front-loaded cartridge type mechanical seals or a Multi Seal arrangement shall be provided on each shaft. Seals shall have either tungsten carbide to tungsten carbide or silicon carbide to silicon carbide seal faces. Springs shall be Hastelloy C (UNS N10276) and other metallic components shall be type 316 stainless steel. Elastomers shall be FKM Fluorocarbon (Viton).

2. The mechanical seals shall be manufactured by John Crane, Chesterton, or Engineer approved equal.

3. The mechanical seal chambers shall be separated from the gear case by an air gap to allow detection of seal leakage and prevent oil contamination.

4. Shafts shall be fitted with replaceable stainless steel sleeves where they pass through the seal chambers.

5. The shafts shall pass through bearing isolators mounted in the gear case wall adjacent to the rotor case to prevent the ingress of contaminants. Bearing isolators shall be of the grease-packed labyrinth type or face type.

2.03 ADDITIONAL CONSTRUCTION REQUIREMENTS FOR BOERGER PUMPS

A. Cartridge type mechanical seals shall be provided. An oil filled quench camber shall be provided to lubricate seal faces. External flush water shall not be provided. Seal faces shall be silicon carbide to silicon carbide.

B. The mechanical seals shall be manufactured by John Crane, Chesterton, or Engineer approved equal.

C. ANSI Class 150 flanged suction and discharge nozzles shall be bolted and gasketed to the center section of the rotor case. Flanges shall be flat-faced.

2.04 ELECTRICAL AND CONTROL REQUIREMENTS

A. Electrical Drive Motor Requirements

Drive	Variable Frequency Drive
Motor Torque	Constant
Speed Range	25% to 100%
Power Source	460VAC, 3 PH, 60 HZ
Maximum Horsepower	30
Maximum Speed, rpm	1,800
Enclosure	TEFC
Insulation	Class H
Inverter Duty	Yes

Service Factor	1.0
Space Heater	Yes
Motor Winding Temperature Switches	Yes

B. Electric motors shall meet the requirements of Division 16.

C. Run Dry Protection System (For Swaby Lobeline)

1. An in-line fluid detection system shall be provided on the suction line to each pump where specified. The system shall be designed to protect pumps from damage caused by an absence of liquid in the suction piping of the pump.

   a. The system must be capable of ignoring errors caused by coating "build-up" on the sensing element. System shall continue to operate with up to 10% of pipe diameter coating on the sensor. Coating could be wet or dry or a series of wet and dry layers.

   b. The system shall consist of an in-line, non-intrusive, ring-shaped sensor with sensor condulet, a remote 120 VAC 60 Hz powered electronic unit, and interconnecting cable.

      i. The sensing element shall be of a non-intrusive design with no moving parts. Flange mounting shall mate with 150# flat faced flanges per ANSI B16.5. The sensing element shall be a 3 terminal type with exposed metal active and shield elements. The sensing element shall be mounted on the suction port of the pump. Flange and pipe size to be as shown in the Contract Drawings. Wetted metal parts to be 316 stainless steel.

      ii. The electronic unit shall be a solid state, radio frequency admittance type, with circuitry designed to ignore errors generated by coating build-up on the sensing element. The electronic unit shall be mounted in a NEMA 4X housing. Liquid presence/absence status shall be indicated with red and green status lights. The unit shall be furnished with empty-pipe fail-safe relay which shall be de-energized to alarm in the event of a malfunction or power loss. The unit shall have as standard an adjustable 0 to a minimum 30 second time delay circuit for pump priming and for preventing premature pump shutdown caused by momentary air pockets. Ambient temperature limits of the electronic unit shall be -40 degrees to 140 degrees F. Outputs shall be DPDT contacts rated 5A at 120 VAC.

      iii. The cable connecting the fluid detector and the electronic unit shall be 4 conductor driven shield type and shall be used to connect the sensing element to the electronic unit. The manufacturer and Contractor shall examine the Drawings to determine the required cable length.

   c. The unit shall be calibrated and adjusted in the field by the pump supplier.

d. The inline fluid detection system shall be Drexelbrook Engineering Company model 506-7032 Series In-Line Fluid Detector, Princo Model L3545 with sensor flange L632 presence/absence detector, or Engineer approved equal.

D. Thermal Dry Run Protection (For Boerger)

1. The unit shall be equipped with a temperature sensing probe which fits in the front cover.

a. The probe shall be a Pyromation RTD assembly, single element, 100 ohm platinum, ¼" diameter 316ss sheath, 3-wire, 3in sheath length; Teflon insulated lead wire, 84in wire length.

2. The sensor cable shall plug into a digital temperature controller.

a. The controller shall be Precision Digital PD570-6RA-10.

b. The unit shall be provided loose and designed for flush panel mount.

2.05 PAINTING AND PROTECTIVE COATINGS

A. Shop Painting and Coating:

1. Electric motors, speed reducers and other non-stainless steel components to have epoxy paint finish per the requirements of Section 09900, Painting

2. The primer and paint used in the shop shall be compatible with the field finish painting.

3. All nameplates shall be properly protected during painting.

4. Apply rust preventative compound to all machined, polished, and nonferrous surfaces that are not to be painted.

2.06 TOOLS AND SPARE PARTS

A. Manufacturer shall furnish spare parts for pumps at the Fiesta Village WRF in accordance with Section 11000, Equipment General Provisions, to include but not be limited to, the following:

One (1) - set of mechanical seals and O-rings for each pump.

One (1) - set of lobes and O-rings for each pump.

One (1) - set of all special tools required for normal operation and maintenance.

PART 3 -- EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 11000, Equipment General Provisions. For each series of pumps, field services shall include the following site visits:

Service	**Number of Trips**	**Number of Days/Trip**
Installation and Testing	1	1
Startup and Training	1	1
Services after Startup	1	1

– END OF SECTION –

SECTION 11170

LIQUID CHEMICAL METERING PUMP SKID

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install liquid chemical metering pump skid for the new hypochlorite system at the locations shown on the Drawings and as specified herein. The liquid chemical metering pump skid shall include metering pumps and all pipe, fittings, valves, electrical and control components as specified herein and to provide for a fully functional system.

B. Equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions and Section 11100, Pumps - General.

C. The manufacturer of the pump skid system shall hereafter be called the “Skid Manufacturer”. The manufacturer of the pumps shall hereafter be called the “Pump Manufacturer”.

1.02 QUALITY ASSURANCE

A. The Skid Manufacturer shall be a company specializing in the manufacture, assembly, and field performance of chemical metering pump skids with a minimum of five years of experience.

B. The Pump Manufacturer shall be a company specializing in the manufacture, assembly, and field performance of chemical metering pumps with a minimum of five years of experience.

1.03 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

A. Chemical Properties: Pumps and pumping components shall be constructed of components suitable for pumping Sodium Hypochlorite with a material concentration of 12%. Physical properties for hypochlorite are:

Chemical	CAS Number	Concentration	pH	BP (^{o}F)	S.G.
Sodium Hypochlorite	7681-52-9	12.5% (V/V)	12.5	230	1.21

B. Pump Performance Requirements

Number of Pumps Installed	Three (3)
Type of Pump	Diaphragm
Pump Capacity	69.7 gph @ 100 psig
Skid Piping	SCH 80 PVC, unpainted
Skid Material	Polyethylene/Polypropelene blend
Suction/Discharge Connector	3/4’’ MNPT

1.03 SUBMITTALS

A. The following items shall be submitted with the Shop Drawings in accordance with, or in addition to the submittal requirements specified in Section 01300, Submittals; and Section 11000, Equipment General Provisions:

1. Performance Affidavit

2. Submit pump manufacturer's hydraulic calculations based on the metering pump schedule attached in this section for review.

B. Shop drawings shall include all pumps and accessories and shall be submitted as a complete system. Partial submittals will be unacceptable.

1.04 WARRANTY AND GUARANTEE

A. The Pump Manufacturer shall provide a minimum two (2) year warranty on the pump itself. The Skid Manufacturer shall provide a two (2) year warranty on the skid which shall cover the skid itself, piping workmanship, valves, controls and accessories, including diaphragm and O-rings.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The Skid Manufacturer shall be a company specializing in manufacture, assembly, and field performance of mechanical metering pump skids with a minimum of five years' experience. Skid Manufacturer shall be Blue Planet Environmental Systems, ProMinent Fluid Controls, or approved equal

B. The Pump Manufacturer shall be Prominent Fluid Controls, Inc., Prominent Sigma Series pumps, or approved equal.

2.02 METERING PUMPS

A. The chemical metering pump(s) shall be microprocessor-controlled, motor-driven, reciprocating, mechanically-actuated diaphragm type - hydraulically actuated metering pumps shall not be acceptable. The pump shall include integral motor, oil-lubricated or permanently greased lubricated bearings, gear reducer and cam-and-spring drive mounted in an aluminum housing. Such housing is to be sealed into an outer plastic housing for corrosion protection.

B. All pumping functions shall be set by membrane-switch keypad and status shall be displayed on an illuminated LCD. It shall include a keypad that allows for simple scrolling and display of programmed parameters.

C. The pump shall be fully tested to meet rated flow and pressure by the manufacturer.

D. The pump shall have a universal power supply which allows it to operate at a supply voltage in the range of 100 VAC-230VAC 50-60Hz +/-10%.

E. The liquid end shall be physically separated from the drive unit by a back plate with weep hole creating an air gap. An elastomer shaft wiper seal shall prevent contamination of the drive if the primary diaphragm fails. The pump shall also have a diaphragm failure detector with a visible indicator of diaphragm rupture. The diaphragm shall be capable of containing chemical for up to 48 hours after failure as a safety feature. There shall also be an option for a fault indication or pump shut down in case of diaphragm rupture.

F. The diaphragm shall be constructed of a steel core, vulcanized into nylon-reinforced EPDM, with PTFE-faced fluid contact surface. The diaphragm shall be of a convex design fitting into a concave liquid end to minimize dead volume and promote flow of solids in suspension.

G. The liquid end shall be virgin PVDF. The suction and discharge valves shall be PVDF with Teflon formed composite seals and Alumina Oxide Ceramic valve balls on PVDF liquid ends. The PVDF liquid end shall be NSF 61 Certified for use with standard water treatment chemicals.

H. Stroke length control shall be adjustable manually by means of a stroke length knob, in increments of 1%, from 0% to 100% of stroke length Stroke length shall be determined by a sensor within the stroke adjustment knob that provides accurate feedback to the electronics of the pump for calibration for LCD display of stroke length. The digital display and optional analog output will calculate, display, and transmit the flow of the pump based on pump speed and stroke length settings.

I. Stroke frequency control shall be done with an integral VFD and stepper motor pump controller. For the integral controller, the first 1/3 of the frequency in strokes per minute will operate with the stepper motor and frequency greater than 1/3 will operate with the internal VFD. Control shall be switchable between manual or external control via 4-20 mA signal. In manual mode, stroke frequency control shall be manually adjusted by touch keypads, with the set stroke rate displayed on the pump's LCD. In external mode, the pump shall be capable of receiving a 4-20 mA input via optional external control cable. The metering pump shall be capable of remote ON-OFF operation using the PAUSE function via a voltage-free contact relay through an optional control cable. Pump shall include TEFC, four-pole AC motor.

J. Vector control or controlled motor magnetization shall be configured into the pump. Such control shall include torque or energy monitoring, allowing for detection of hydraulic defects such as discharge overload, with consequent pump shut-down.

K. The pump shall include a removable HMI mounted on the pump for interface with the skid control panel.

L. Programming

1. The pump shall be calibrated to display pump output in gallons/hour. Calibration shall be maintained when stroke length is altered up to +/- 10% on the stroke length

knob. If stroke length is altered by more than 10%, a yellow warning light shall illuminate and a flashing message “calib” will appear to avoid uncalibrated chemical feed.

2. The pump shall be equipped with the programmable function of electronic interlocking of the keypad by access code to prevent unauthorized adjustments to the pump.

3. Keypad shall allow for scrolling and display on LCD such parameters as stroke frequency, stroke length, stroke counter, pump output in gals/hr, dosing quantity, mA current input being received by pump, and indication of external mode.

4. Keypad programming shall allow for selecting fast or slow suction and discharge stroking profiles. Such variable dosing profiles shall allow for potential reduction in $NPSH_r$ or more laminar discharge stroke.

2.03 METERING PUMP SKID ASSEMBLY

A. Each pump shall have the ability to function as an isolated pump (i.e., independent of piping and operation of the other pump mounted on the skid assembly). The two end pumps shall be dedicated to feed one of the two discharges. The middle pump shall be valved to be allowed to backup either of the end pumps. Selection for use of backup pump shall require manual manipulation of valves at the skid and controls at the plant control display.

B. The chemical feed skid system shall be completely assembled, mounted, calibrated, tested, and delivered to the site on a single skid. Skid assembly shall contain chemical metering pumps, all necessary piping, valves, fittings, supports, electrical controls, and accessories as specified herein. The metering pump skid shall contain the following items:

1. Skid
2. Metering pumps with manual stroke length adjustment
3. Pump motors
4. Calibration columns
5. Pulsation dampeners
6. Pressure gauges with diaphragm seals
7. Isolation valves
8. Pressure relief valves
9. Backpressure valve
10. Wye strainer(s)
11. Skid mounted control panel and controls

12. All piping, valves, gaskets, supports, hardware, wiring, junction boxes, and accessories necessary for a fully functioning skid. Piping shall be terminated within 2 inches from the edge of skid. Provide flanges at all piping connections leaving the skid for any pipes > 1/2" and unions for any pipes ≤ 1/2". Electrical cables to the skid shall terminate in the skid-mounted control panel.

C. All components of the chemical metering system shall be contained within the skid. Skids shall be floor mounted units with bottom, back, and sides of the skid frame constructed from black UV-protected, fusion-welded, high-density polyethylene of a minimum thickness suitable to rigidly support the weight of the equipment and the chemical metered without warping or bending of any kind. Bolted construction for the frame is not acceptable. The top and front of the skid shall be constructed of clear plastic material provided as a spray shield. Top shall be removeable and front shall be provided with hinged doors for full access to the skid interior with all piping and equipment able to be easily serviced with the doors open and/or top removed. All fasteners and hardware shall be non-metallic and of suitable strength and thickness to be of solid, rigid construction.

D. Pedestals shall be provided to elevate the metering pumps above the skid base and all piping and components shall be supported to prevent them from resting on the skid deck. The skid shall incorporate a drip lip with two (2) 1/2" NPT connections for containment drain piping. Skid shall be constructed with forklift truck cut-outs and anchor bolt holes for installation. Skid shall be suitable for outdoor installations.

E. The wetted end of each pump shall be oriented at the open end of the framework for easy access. All pumps shall be arranged with the pump wet end facing the open end of the feed system. Where local control panels will be located on the skid, all panels shall be mounted so that the control interface faces the top or front open end of the skid.

F. All components of the skid mounted system (pumps, piping and controls) shall be factory pressure tested with water prior to shipment. Certification of factory testing shall be submitted to the Engineer and included in the Operations and Maintenance Manuals.

G. All metering pump accessories shall have pressure ratings equal to or greater than the discharge pressure of the associated metering pumps.

H. All wiring within the skid boundaries shall be performed by the chemical feed system fabricator prior to shipping and shall terminate at the skid-mounted control panel.

I. Calibration Chamber: Provide one clear PVC calibration chamber with vent for use in calibrating the metering pumps. The chamber shall be sized to give adequate capacity for a minimum 30 second draw down test at maximum pump capacity. The scale shall give direct readings in GPH without the need for calculations. The calibration chamber shall be piped and valved so that each pump shall be able to utilize the calibration chamber without interfering with the operation of the other pump. The top of the chamber shall be piped to a common vent on the skid.

J. Pulsation Dampeners:

1. Diaphragm and body materials and configuration shall be supplied for the specific chemical for which the dampener is used without corrosion, wear, or other cause of abnormally short life.

2. Pulsation dampeners shall be of the single diaphragm design, capable of arresting water hammer in the pump discharge lines created by the metering pumps.

3. Pulsation dampeners shall be provided with valves, gauges and fittings necessary for maintaining required air pressure in the air chamber.

4. Materials of construction of diaphragm shall be EPDM and body shall be PVC. All materials shall be corrosion resistant to the chemical fluid pumped.

5. Provide one dampener on the discharge side of each metering pump, located 12" or closer to the pump discharge.

6. Each pulsation dampener shall include an integral pressure gauge.

7. Provide each pulsation dampener with an isolation valve.

8. Pulsation dampeners shall be sized appropriately for each pump to remove a minimum of 95% of the pulsations. The manufacturer shall submit calculations to verify sizing with Shop Drawings.

K. Pressure Gauges - Gauges shall be provided on the discharge of metering pump skid and on each pulsation dampener. Gauges shall be PVC housing, nominally 2.5" in diameter. Each gauge shall have a pressure range suitable to allow the normal pumping pressure to be near the mid-span of the range. Each gauge shall be provided with a diaphragm seal constructed of materials which are completely resistant to corrosion by the pumped chemical. Each pressure gauge shall be provided with a 1/2" isolation ball valve.

L. Pressure Relief Valves – Pressure relief valves shall be provided in the discharge piping of each metering pump, prior to any valves, to eliminate the buildup of excess pressure in the system. Valves shall be completely resistant to the chemicals for which they are provided. The pressure relief valves shall be fully adjustable from 0 – 150 psi. Relief vents shall be piped to the suction side of the associated pump.

M. Antisiphon/Back Pressure Valves – Back pressure/anti-siphon valves shall be provided in the discharge pipes of the skid to provide constant back pressure at the chemical metering pump discharge and eliminate siphoning. Valves shall be completely resistant to the chemicals for which they are provided. The back pressure valve shall be fully adjustable from 0 – 150 psi.

N. Piping, Valves and Appurtenances:

1. Furnish hard piping on the suction and discharge of each metering pump as shown on the Drawings.

2. Isolation valves shall be provided at all equipment connections. Seals shall be compatible with the chemical being pumped.

3. Valves shall be true-union ball valves.

4. Feed system piping shall include an air bleed/flush connection on the suction and discharge of each pump. The bleed/flush connections should be located on the interior of the pump isolation valves to allow for all lines to be purged of air after the bulk tank is filled and allow the pump to be flushed prior to maintenance being performed.

5. Provide flexible piping connection and quick connects or unions with flanges between fixed piping and suction and discharge of the pump in order to allow removal of the pump without disturbing the suction or discharge piping.

6. All piping and accessory support shall be from the skid base or rear panel. Piping and accessory support from above is not acceptable.

7. All piping and accessories shall be securely fastened to the frame or supported with stand-offs. The use of steel or metal bands or strapping shall not be acceptable.

8. Provide transition fittings for connection of dissimilar materials or provide metering pump accessories manufactured of the same material as the piping.

9. No threaded piping will be allowed on the skids.

2.04 LOCAL CONTROL PANEL (LCP)

A. The skid shall be provided with a Local Control Panel (LCP) with 120V power fed from a lighting panel as indicated on the Drawings. The LCP shall be mounted on the exterior of one side of the skid as indicated on the Drawings. Power to each pump shall be distributed and fed from circuit breakers within the LCP to individual corrosion resistant, GFI, weatherproof duplex receptacles mounted near the top interior back plate of the skid to act as local disconnect. LCP enclosure shall be NEMA 4X FRP construction.

B. The LCP shall provide all the functions and interfaces specified and shall include a main circuit breaker and branch circuit breakers for each pump and for control logic.

C. Each pump shall have the following devices mounted on the door of the LCP for operator interface

1. Hand/Off/Remote selector switch
2. Red running light for each pump
3. Amber alarm light for each pump
4. Speed control digital potentiometer when in Hand
5. Pump speed indication

Selector switches, indicator lights, and potentiometer shall be rated NEMA 4X, Allen Bradley Bulletin 800T or approved equal. Speed indicator shall be a 4-digit LCD, backlit, NEMA 4X digital indicator with range of 0.0 to 100.0%, as manufactured by Red Lion DT8, or approved equal.

D. The LCP have the following interface to the new Hypochlorite PLC Control Panel (HPCP) provided under Division 17:

1. Pump running status for each pump
2. Pump alarm status for each pump
3. Pump speed 4-20mA feedback for each pump
4. Pump In Remote status for each pump
5. Pump speed 4-20mA reference command to each pump
6. Pump start enable command for each pump

E. Wiring and conduit between the LCP and the HPCP shall be supplied and furnished under Division 16. Contractor shall coordinate between the Pump/Skid Manufacturers and the Division 16 electrical subcontractor to provide the appropriate number, size, and type of wire required for the needed wiring interface. Wiring and conduit between the LCP and skid components shall be factory pre-wired and follow all requirements of Division 16 for wiring and conduit except all conduit shall be SCH80 PVC, rigid or flexible as needed to meet applicable codes.

F. Pumps shall be furnished with motors such that the motor shall not be overloaded throughout the full range of the pump operation. Voltage to each pump shall be 115VAC single phase, 60 HZ.

2.05 TOOLS, SUPPLIES AND SPARE PARTS

A. The Skid and/or Pump Manufacturer shall furnish all special tools necessary to disassemble, repair and adjust the equipment.

i. In addition to any other spare parts recommended by the Pump Manufacturer the Skid Manufacturer, furnish the following spare parts:

1. Two (2) spare pressure gauges with diaphragm protectors
2. One (1) spare pressure relief valve
3. One (1) spare back pressure valve
4. One (1) spare pulsation dampener
5. Two (2) preventive maintenance kit including all components required to rebuild pump head

PART 3 -- EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified Pump and/or Skid manufacturer's technical representative shall be provided as follows:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	1	1
Startup and Training	1	1
Services after Startup	1	1

B. Manufacturer's technical representative shall perform the tasks as follows for each set of metering pumps:

1. Witness and check installation.

2. Assist the Contractor in conducting field tests and preparing a written report as specified below.

3. Provide all necessary field adjustments of pressure settings for the pressure relieve valves, backpressure valves and pressure switches supplied (as supplied per this Section).

4. Witness and check start-up of the system.

5. Assist Contractor in making adjustments and modifications as necessary to optimize operation of the system components and to minimize surge pressures.

6. Troubleshoot and correct any mechanical or control problems with the metering pumps and accessories that are noted during tests and start-up.

7. Submit written certification that the system has been properly installed, tested, and adjusted; that the system operates as specified or as required; and that all controls and protective devices operate properly, including date of final acceptance test, as well as a listing of all persons present during the tests.

8. Investigate and supervise correction of any operating problems that may arise up to the end of the guarantee period of the pumps.

9. Instruct Owner in the operation and maintenance of equipment.

C. The Contractor shall be fully informed and shall be responsible to ensure that all Contractor's employees, agents, and/or subcontractors are fully informed as to the hazards and proper procedures associated with working with and around the specified chemicals.

3.02 INSTALLATION

A. The Contractor shall furnish and install the metering pumps and all associated equipment and accessories as required and specified herein in accordance with manufacturer's instructions and in accordance with Section 11000, Equipment General Provisions.

B. All fasteners, brackets, mounting hardware, and accessories located in the storage and feed areas shall be constructed of non-metallic materials completely resistant to the specified chemicals.

3.03 TESTING, CLEANING, AND START-UP

A. All pumps shall be shop tested for capacity at rated pressure prior to shipment, with documented results provided.

B. The Contractor shall demonstrate to the Engineer that the completed systems meet the functional requirements intended and that all components of the system are properly calibrated.

C. After installation of piping and accessories but before connection of piping to the storage tank and pumps the Contractor shall completely flush the system to clean and remove all foreign matter from the piping system.

D. After chemical storage tanks are hydrostatically tested and the tanks and piping system are cleaned, complete system hydrostatic tests and operational tests shall be completed with potable water. The Contractor shall check the functioning of all pump accessories, valves, and feed points and shall repair or replace all malfunctioning or unsatisfactory components. The Contractor shall repair all leaking joints and components identified during the test and through the one-year guarantee period.

E. Prior to placing the required chemicals in any tank, pipeline or piece of equipment, the same shall each be blow dried to remove all moisture and any other material that could contaminate the chemicals to be used.

F. Contractor shall demonstrate and document the accuracy of each pump using project-supplied calibration chamber.

- END OF SECTION

SECTION 11325

LIQUID POLYMER PREPARATION SYSTEMS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The Contractor shall furnish and install complete liquid polymer preparation systems, as specified herein and as indicated on the Drawings. Additionally, the Contractor shall coordinate installation of the polymer storage totes, tote weigh scale, and tote mixers to provide a complete and operable polymer dosing system.

B. Equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions. Before submitting shop drawings, the Contractor shall verify spatial requirements to ensure that the equipment supplied will fit in the space allotted on the Drawings.

C. The liquid polymer preparation systems shall be designed to dilute and activate liquid neat emulsion polymer for downstream application in a high solids centrifuge dewatering process.

D. The County's current polymer product, as of the writing of this specification, is Polydyne Clarifloc SE-1080. The Liquid Polymer Preparation System Supplier shall verify the County's current polymer product during submittal development and confirm the performance requirements can be met based on the current polymer product during submittal development.

E. All polymer system equipment including liquid polymer preparation system, tote mixers, recirculation pumps and polymer dosing pumps shall be supplied by the Liquid Polymer Preparation System Supplier in order to achieve standardization for appearance, testing of complete system performance, operation, maintenance, spare parts and service. It is the intent of this specification to obtain an installation complete in every necessary detail whether or not covered by the specifications, and any omission of required equipment from the specifications shall not relieve the manufacturer of its responsibility for the satisfactory installation and operation of all required equipment specified in this section.

F. The Contractor shall have unit responsibility for coordination of all structures, controls, piping and appurtenances with all interrelated equipment as may be specified elsewhere in these documents to provide a complete and operable system.

1.02 PERFORMANCE REQUIREMENTS

A. The liquid polymer preparation systems provided shall meet the following performance requirements:

Number of Units	2 (1 operational, 1 in-line standby)
Centrifuge Solids Loading, Maximum, dry lb TS/hr	2,400
Centrifuge Feed Solids, Range (% weight)	0.90 – 1.90
Design Polymer Dose Rate, lb active polymer solids/ton dry solids	30.0
Design Polymer Dose, lb active polymer solids/hr	36.0
Design Neat Emulsion Polymer Solution Strength, %APS	41.0
Polymer Density, lb neat/gallon (based on current polymer in use)	9.17
Design Neat Polymer Flow, gal/hr	10.5
Dilution Polymer Concentration Range (by volume)	0.30% - 0.50%
Design Dilution Water Flow Rate (maximum), gpm	60.0
Neat Polymer Pump Turndown	20:1
Dilution Water Pump Turndown	10:1
Anticipated Dilution Water Supply Pressure Range to Polymer Preparation Systems	35 to 55 psi
Minimum Required Pressure at Point of Discharge from the Polymer Preparation System, psig **(This is at the polymer preparation system, not at the polymer injection point)**	35 psi
Electrical Power Feed	460 VAC/ 3-PH / 60HZ

B. The system shall be designed to fully activate neat emulsion polymers and provide dilute polymer feed solutions to downstream application points without additional polymer solution mixing.

1.03 SUBMITTALS

A. Shop Drawings shall be submitted in accordance with the submittal requirements specified in Section 01300, Submittals; and Section 11000, Equipment General Provisions.

B. Shop Drawings:

1. Submit for approval the following:

a. System information as a complete submittal including external connections and internal details.

b. Complete description in sufficient detail to permit comparison with the technical specifications.

c. Weights and performance data.

d. Wiring diagrams and specifications for electrical equipment.

e. Affidavits of compliance with referenced standards and codes.

f. Manufacturer's literature, including:
   1) Dimensions
   2) Materials
   3) Sizes
   4) Weights
   5) Motor information

g. Confirm that equipment and piping shown is suitable for service conditions specified.

h. Show locations and sizes of connections to associated equipment and utilities.

i. All drawings to be provided in both orthogonal and isometric views.

j. Warranty information.

C. Field Tests:

1. Submit proposed polymer system testing protocol for approval by ENGINEER.

2. Submit a written report giving the results of the required field tests.

D. Manufacturer’s Services: Submit a written report of the results of each visit by a manufacturer's service representative including purpose and time of visit, tasks performed, and results obtained.

E. Operation and Maintenance Data: Submit for approval operation and maintenance data in a form that complies with Division 1.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the Site to ensure uninterrupted progress of the Work. CONTRACTOR shall deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.

B. Inspect boxes, crates and packages upon delivery to the Site. Notify ENGINEER of loss or damage to equipment or components. Replace losses and repair damage to new condition, in accordance with manufacturer's instructions.

C. Store materials to permit easy access for inspection and identification. Keep material off the ground, using pallets, platforms, or other supports. Protect equipment including packaged materials from corrosion and deterioration.

1.05 GUARANTEE AND WARRANTY

A. In addition to the requirements of Division 0 and Division 1, the CONTRACTOR shall require the manufacturer to furnish a warranty valid through the warranty period to assure that any equipment specified herein which does not meet the performance requirements for the specifications, is repaired to the COUNTY's satisfaction or replaced with equipment that does meet the performance requirements of the specification. The warranty shall be for minimum period of two years from the date of acceptance by the County for the work associated with the equipment specified herein.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The liquid polymer preparation systems shall be DynaBlend L Series by Fluid Dynamics VeloDyne VeloBlend VM Series, or Equal.

2.02 GENERAL REQUIREMENTS

A. Due to pressure drop across the liquid polymer preparation unit, an integral dilution water booster pump shall be provided. The dilution water booster pump shall be sized based on the anticipated dilution water supply pressure, the anticipated downstream backpressure, and the pressure drop across the liquid polymer preparation system. The dilution water booster pump shall be mounted to the liquid polymer preparation skid and shall be powered and controlled from the liquid polymer preparation system local control panel. The dilution water pump shall have stainless steel wetted components and be supplied with a TENV or TEFC electric motor. The motor starter shall be located in the liquid polymer preparation system local control panel and comply with the applicable requirements of Division 16, Electrical.

B. The liquid polymer preparation system frame shall be of rugged 304 stainless steel construction. Mild carbon steel is not acceptable. The skid and frame assembly shall be constructed of 3/16" angle or structural stainless steel tubing. The back plate supporting the control panel shall be a minimum 12-gauge thickness stainless steel. Vertical frame members shall be gusseted to the base. All pipe supports shall be stainless steel. Piping and valves shall be mounted with rigid pipe clamps. The skid shall be designed for fork-lifting and shall have holes for mounting to concrete pad. The system's frame shall be designed for the integral dilution water booster pump, if required.

C. All piping of the liquid polymer feed system shall be constructed of Schedule 80 PVC, unless otherwise specified or shown on the Drawings.

E. The liquid polymer feed system shall be supplied with a neat polymer check valve designed to isolate the neat polymer from the dilution water upstream of the mixing chamber. The valve shall be designed with an open, unobstructed path to the valve seat. Valve construction shall be PVC, stainless steel, and Viton. The valve shall be readily accessible for cleaning and maintenance. The check valve shall not be installed within the mixing chamber assembly or require mixing chamber disassembly for maintenance and servicing.

F. A calibration chamber shall be provided on the neat polymer inlet piping to the liquid polymer feed system. Provide one clear PVC calibration chamber for use in calibrating the polymer feed pump. The chamber shall be sized to give adequate capacity for a minimum 30 second draw down test at maximum pump capacity. The scale shall give direct readings in GPH without the need for calculations.

G. The dilution water system shall have the ability to perform a flush cycle at the end of a run cycle, which sends dilution water downstream of the booster pump to the injection point. This will allow for removing any clogs in the dilute polymer line to the injection point.

H. The dilution water piping on the suction side of the booster pump shall include a wye strainer.

2.03 MIXING CHAMBER

A. DynaBlend - Non-Mechanical Hydrodynamic Activation Chamber

1. The liquid polymer activation chamber's mixing energy shall be staged such that it provides for high, non-damaging mixing energy over the full operating range of the system which then dissipates through four concentric chambers. The integral water control device, which shall also produce mixing energy by creating a pressure drop across its orifice, shall be constructed of stainless steel and brass and shall be designed to allow orifice replacement without disassembly of any other part of the system.

a. The integral water control device shall consist of, at a minimum, a dilution water booster pump with a downstream pressure regulating valve and upstream and downstream pressure gauges to provide control over mixing energy over the operating range of the polymer preparation system.

2. A mixing chamber drain valve with 1/2" fitting shall be provided and plumbed to the nearest floor drain. The mixing chamber shall have a maximum rated pressure of 150 psi. The mixing chamber shell or body shall be constructed from 304-stainless steel. PVC internal components are acceptable.

B. VeloBlend - Multi-zone Hydro-mechanical Mixing Chamber:

1. A hydro-mechanical blending device shall be provided. The dilution water booster pump shall be sized and controlled to provide the desired differential pressure across the polymer system (30 psig). In addition, the system shall be capable of producing its mixing energy independent of differential water pressure through a variable intensity, controllable stainless steel mechanical mixer. The system shall be capable of producing high, non-damaging mixing energy at all flow rates without damage to the polymer's molecular structure. In order to prevent polymer build-up, the mixing chamber shall maintain high velocity in the entire chamber. At no time shall there be low velocity within any portion of the mixing chamber.

2. Both the mechanical and non-mechanical mixing zones shall be clear Lexan to view the mixing action and blending effectiveness.

3. The mixing chamber shall have a maximum rated pressure of 100 psi. A pressure relief shall be provided on the mixing chamber, adjustable between 25 and 100 psi. The valve shall have a stainless steel or PVC body with stainless steel, Viton and Teflon internals.

4. A variable speed stainless steel mechanical mixing impeller shall be provided. Plastic impellers shall not be acceptable. The impeller shall be designed to produce both axial and radial flow to optimize mixing effectiveness and to effectively inducing high, non-damaging mixing energy over the systems full flow range. The specially designed impeller shall be controlled by an SCR motor controller and driven by a wash-down duty 1 HP (maximum) TEFC motor. The mixer drive shaft shall be sealed by a mechanical seal which shall have an integrally mounted and factory plumbed seal flushing valve. A drain port behind the seal shall be provided in the mixing chamber to drain the polymer solution in case of a seal failure. The seal shall be easily accessible for replacement. All bearings shall be external from the mixing chamber. Internal bearings shall not be acceptable. Systems which rely on high shear and or constant speed impellers or that rely on close tolerances for blending shall not be acceptable.

5. The motor shall conform to the applicable requirements of Section 16150 – Electric Motors. The motor shall be direct-coupled to the impeller shaft.

2.04 DILUTION WATER CONTROL

A. DynaBlend and VeloBlend

1. The dilution water inlet assembly shall include an inlet fitting as indicated below, NEMA 4X dilution water solenoid valve, rotameter or paddle type flow meter with a range appropriate for the specified dilution water capacity, stainless steel liquid filled dilution water inlet pressure gauge, and stainless steel and brass water

control valve. Plastic control valves shall not be acceptable.

2. Dilution water control shall include a pressure regulating valve and appropriate pressure indicating instruments to regulate and control the pressure of dilution water as required by the polymer unit. Pressure regulating valve and pressure indicating instruments shall be appropriate for and accommodate the specified pressure range of the dilution water.

2.05 NEAT POLYMER FEED PUMP

A. The liquid polymer preparation system shall be supplied with a neat polymer-metering pump. The pump shall be positive displacement, progressive cavity type. The rotor shall be 316 SS or Zytel. The stator shall be Viton. A packing system shall be provided for the pump shaft seal.

B. The pump shall be driven by a ½ HP (maximum), 0–90V DC motor. The neat polymer pump speed shall not exceed 400 rpm. The speed of the pump shall be controlled by an SCR motor controller mounted in the control panel. The motor shall be washdown, TENV duty. The motor shall be direct-coupled to a gear reducer. The pump also shall be direct-coupled to the gear reducer.

C. A pressure relief valve shall be provided on the neat polymer feed pump discharge piping and piped to relieve pressure back to the pump suction.

2.06 POLYMER INJECTION ASSEMBLY

A. The main dosing point for polymer solution shall be directly into the feed pipe upstream of the centrifuge, per the Centrifuge manufacturer's recommendation. Two alternative dosing points into the centrifuge sludge feed line within the Dewatering Building shall be provided as shown on the Drawings.

B. The polymer system manufacturer shall provide a polymer injection assembly for each alternative dosing point. The polymer injection assembly shall be as recommended by the polymer system manufacturer and shall be appropriate for the type of polymer used and for centrifuge dewatering operations. All wetted parts shall be made of materials suitable for service with dilute emulsion type polymers.

C. The polymer system manufacturer shall coordinate with the Contractor to ensure adequate space is provided in the centrifuge feed piping for the injection assembly.

2.07 TOTE MIXER

A. A bladed, electric tote mixer shall be furnished and installed by the Contractor as part of the polymer dosing system. One bladed propeller tote mixer shall be provided for each 275 gallon polymer storage tote to help keep the emulsion from stratifying and provide a more consistent chemical to the polymer preparation units. The tote mixer shall be Gamut (A Grainger company) or approved equal.

B. The tote mixer shall be compatible with the polymer storage totes with respect to mounting type and shaft length. Mixing speed shall be verified with the polymer chemical provider, so as not to damage the polymer chemical bonds. Tote mixer construction shall be as follows:

1.	No. of Propeller Blades:	Two
2.	Shaft:	316 Stainless Steel, 1-inch diameter round. Shaft shall have a quick release connection for removal.
3.	Propeller Blade pitch ratio/type:	1:1 (machine)
4.	Mounting Location/Type:	Thread into bung on top of polymer storage tote.
5.	Propeller size and type:	9-inch diameter, 316 Stainless steel, folding type propeller to allow for insertion into the tote.
6.	Motor:	Maximum 0.5 hp, TEFC, 120V, 1 phase, 60 Hz, 450 rpm (maximum)
7.	Electrical Connection:	Shall have a corded plug for power from a nearby outlet.
8.	Spare Parts:	Two complete shaft and blade sets.

2.08 POLYMER TOTE SCALES

A. Polymer feed equipment manufacturer shall supply two polymer tote scales with the following features:

1. Each tote scale shall have a minimum 5000 lb capacity and shall be of the digital readout/electronic load cell type.

2. Each scale platform shall be sized to accept a 40 inch by 48 inch 275 gallon tote. Platform height shall be no more than 3.5 inches to permit easy loading and unloading of totes.

3. Each platform scale shall be constructed of Type 316 stainless steel.

4. Each scale shall be of the single load cell design. Weight shall be transferred by a pivoted platform to a single, National Type Evaluation Program (NTEP) approved load cell of the shear beam strain gauge type. Flexible cable shall connect load cell to indicator to allow easy remote installation of the readout. Cable length shall be 20 feet.

5. A remote mounted LCD indicator shall be housed in a NEMA 4X, UL approved enclosure. LCD indicator shall be backlit with 0.5 inch characters for ease of readability in low light conditions. To allow indication of net weight, indicator shall be equipped with a sealed ten-turn knob for tare adjustment. Indicator shall output net weight via a 4-20 mA signal for remote monitoring. Indicator shall have two adjustable set points for alarms or liquid level control.

6. Full scale accuracy shall be better than 0.0025 percent.

7. Scale manufacturer shall warrant the equipment as specified in Paragraph 1.05.

8. Scale Manufacturer and Model:
   a. Trinner Model TS-SS 5x5 Stainless.
   b. Force Flow IBC Tote Scale, Model 60-DR50TBS and SOLO-G2 digital display.
   c. Or approved equal.

2.09 ELECTRICAL AND CONTROL REQUIREMENTS

A. Each liquid polymer preparation system shall operate from a control panel that shall power and control the individual components of the system as required. All interconnecting power and control wiring necessary for a complete installation shall be the responsibility of the equipment manufacturer and/ or the Contractor. The control panel shall include the following as a minimum:

1. Single point power connection from a 460 VAC, three-phase, power source for the entire system. Provide a step-down transformer as required for 120 VAC and/ or other voltages required.

2. Main disconnect switch for the incoming power with operating handle that shall be pad-lockable in the OFF position.

3. Motor starters and SCR controllers as required for all motors furnished.

4. Controls for all liquid polymer preparation system equipment including water booster pump and mixer as required.

B. All conduit, couplings, fittings, and fasteners furnished by the equipment manufacturer shall be PVC coated rigid galvanized steel and liquid tight, PVC coated, flexible metal conduit. All conduit shall be supported as specified within Section 16190 – Supporting Devices. Liquid tight flexible metal conduit shall be supported a minimum of every three feet.

2.10 CONTROL PANEL

A. The liquid polymer preparation system shall be provided with a skid mounted NEMA 4X stainless steel local control panel (with an input circuit breaker main power ON-OFF switch and pilot light to indicate a power ON operating condition. The local control panel shall consist of all programmable controllers, switches, relays, indicator lights, digital displays, and other auxiliary devices as required to provide the functional capabilities described herein. The local control panel, and its components, shall be industrial duty fully suitable for the application environment. The local control panel shall be furnished with a numbered terminal block, with legend, suitable for connection of 14 AWG wire for remote signal capability. Electrical equipment in the local control panel shall conform to the applicable NEMA and NEC standards. Pilot devices and relays shall be as specified in Section 16902, Electric Controls and Relays.

B. The local control panel shall be provided with a LOCAL-OFF-REMOTE selector switch. When the LOCAL-OFF-REMOTE selector switch is in the LOCAL position, the unit shall operate based on RUN/STOP and SPEED input from the local control panel. The speed input from the local control panel shall be a 4-20 mA analog pacing signal from the local control panel 10-turn potentiometer. When the LOCAL-OFF-REMOTE selector switch is in the OFF position, the unit shall not operate.

C. When the LOCAL-OFF-REMOTE selector switch is in the REMOTE position the unit shall operate based on RUN/STOP input from the PLC. The polymer preparation system neat polymer feed pump speed command shall be a 4-20 mA analog pacing signal from the Centrifuge PLC.

D. The liquid polymer preparation system shall be supplied with a dilution water loss of flow sensor. The dilution water loss of flow sensor shall be a NEMA 4X, industrial duty differential pressure switch. The sensor shall place the polymer pump on standby if the dilution water flow has been interrupted for any reason and shall automatically restart the polymer pump when the water flow is restored. An integral timer shall monitor loss of dilution water flow and energize the contacts to provide an alarm after 15 seconds of continuous loss. The controller shall indicate loss of water alarm with LED.

E. The liquid polymer preparation system shall be supplied with a sensor to indicator loss of polymer to the neat polymer feed pump. The sensor shall be of the thermal type. The sensor shall place the polymer pump on standby if loss of polymer flow is detected. Loss of polymer flow shall require a manual system restart.

F. The liquid polymer preparation system local control panel shall have the following I/O signals to interface with the centrifuge control system:

    1. Polymer Preparation System – Flow Pacing (4-20 mA signal from the Centrifuge PLC)

    2. Polymer Preparation System Control Mode (dry contact from L/O/R switch to dewatering equipment PLC)

    3. Polymer Preparation System Shutdown Alarm Status (dry contact from general shutdown alarm to dewatering equipment PLC – any alarm or E-Stop)

    4. Polymer Feed Rate – Flow Feedback (4-20 mA signal to the Centrifuge PLC)

    5. Polymer Preparation System Status (dry contact from system running status to dewatering equipment PLC)

G. The liquid polymer preparation system local control panels shall have the following indicating lights and devices mounted on the front door:

    1. SPEED INDICATION – Neat Polymer Feed Pump

    2. ALARM – Loss of Polymer Flow

    3. ALARM – Loss of Dilution Water Flow

4. System speed control potentiometer
5. System LOCAL-OFF-REMOTE selector switch
6. Neat Polymer Feed Pump “RUN” status
7. Neat Polymer Feed Pump “FAIL” Status
8. E-Stop
9. E-Stop alarm light

PART 3 – EXECUTION

3.01 MANUFACTURER’S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 11000, Equipment General Provisions and shall include the following site visits:

Service	Number of Trips
Installation and Testing	1
Startup and Training	1
Services after Startup	1

3.02 FIELD TESTING

A. Field testing shall be in accordance with the requirements of Section 11000, Equipment General Provision.

B. The system supplier and Contractor shall demonstrate to the Engineer that the polymer system meets the functional requirements intended and that all components of the system are properly adjusted and calibrated and operate reliably.

C. After the system is cleaned, a complete system hydrostatic and operational test shall be completed with potable water. The Contractor shall check the functioning of all system components including instruments and controls. The Contractor shall repair or replace all malfunctioning or unsatisfactory components identified during testing, start-up, and through the guarantee period.

D. The Contractor shall provide a sufficient quantity of polymer for a 48-hour performance test period after hydrostatic and operational tests specified above are completed and approved. The type and make of polymer shall be as approved by the County. Scheduling of the performance tests shall be approved and witnessed by the Engineer and the County's field representative.

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SECTION 11375

HIGH SOLIDS CENTRIFUGE EQUIPMENT

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, test, and place into satisfactory operation one (1) high solids centrifuge assembly at the Fiesta Village WRF, including control panel and all ancillary equipment as specified herein, or as otherwise required for a complete and operable high solids centrifuge dewatering system.

B. The County currently utilizes a mobile dewatering unit at the Fiesta Village WRF, which includes a Centrysis CS 26-4 centrifuge unit, and has been in service since 2008.

C. Equipment shall be provided in accordance and in compliance with the requirements of Section 11000, Equipment General Provisions.

D. Equipment furnished by the Centrifuge Manufacturer under this Section shall include, but not be limited to: (a) one high solids centrifuge assembly of the continuous feed solid bowl type with a horizontal scroll conveyor suitable for either continuous or intermittent operation; (b) one centrifuge control panel assembly, (c) one air/oil lubrication panel and system, (d) one compressor and compressed air system, and (e) one washwater booster pump system. The Centrifuge Manufacturer shall design the components of each assembly for the stresses that may be experienced during fabrication, shipment, erection, operation and maintenance.

E. The Centrifuge Manufacturer shall have a permanent, full-time in-house engineering and service staff located in North America, fully familiar with the design, fabrication, installation and operation of municipal sewage sludge high solids centrifuges of similar size and capacity as the high solids centrifuge proposed for this installation.

F. The Centrifuge Manufacturer shall have a minimum of five (5) years experience in North America in the installation and service of high-solids type centrifuges similar in design, size and capacity to that described in these Specifications. The Centrifuge Manufacturer shall submit evidence of at least ten (10) North American high-solids centrifuges currently in operation that have successfully passed performance testing and are of comparable, or larger, size (i.e., bowl diameter); capacity (i.e, hydraulic and/or solids throughput); and configuration (i.e., dual VFD main and backdrive) to the unit submitted under this Section. Each unit submitted for consideration as a reference under this paragraph shall have been in operation a minimum of two (2) years after successful completion of the performance testing. Any high solids centrifuge built in the past, but not currently in operation or operable condition, will not be considered toward the ten (10) required reference units.

1.02 OPERATING CONDITIONS AND MANUFACTURER'S PERFORMANCE GUARANTEE

A. For the Fiesta Village WRF, the high solids centrifuge shall be designed and furnished to dewater thickened waste activated (secondary) sludge from treatment of influent

wastewater. The thickened waste activated sludge is derived from waste sludge from secondary clarifiers that has been digested in upstream aerobic digesters. The sludge shall not contain metal or material not typically found in municipal wastewater treatment plant sludge. The FVWRF sludge production rate is 9,000 dry lb/day annual average load with a max week loading of 20,400 dry lb/day. The sludge will have the following feed conditions:

	Minimum	Average	Maximum
a. Temperature	50°F	80°F	105°F
b. Feed Solids (by Weight)	0.9%	1.14%	1.9%
c. pH	6.5	7.5	8.5

B. The furnished equipment shall be capable of meeting the specified performance requirements when the feedstock is within the range specified in the above paragraph. No warranty is made for other characteristics of the liquid sludge feedstock beyond that described in the above paragraph.

C. The sludge feedstock to the high solids centrifuge dewatering unit shall be chemically conditioned prior to dewatering with a dilute organic polymer solution to enhance solids separation and solids capture efficiency. The dilute polymer solution shall be prepared using emulsion polymer preparation systems furnished by the Contractor and as specified elsewhere in the Contract Documents. The Centrifuge Manufacturer shall review the process capability and performance requirements associated with the emulsion polymer preparation systems in the selection of equipment to be provided under this Section of the specifications.

D. Sludge will be fed to the centrifuges by rotary lobe positive displacement pumps as specified in Section 11160.

E. If the equipment fails to perform as guaranteed based on performance testing requirements specified elsewhere herein, the Centrifuge Manufacturer shall modify the equipment or provide additional operational assistance, as required, to meet the specified performance requirements without additional costs to the County.

F. In the event that the performance requirements cannot be achieved within 90-calendar days of the start of the first performance trial; then the Centrifuge Manufacturer shall provide payment to the County for failure to achieve the performance requirements as specified elsewhere in the specifications.

1.03 PROCESS PERFORMANCE REQUIREMENTS

A. Feed solids concentrations to the high solids centrifuge dewatering unit process are variable within the operating range described above. The performance requirements for the high solids centrifuge will be governed by either a minimum solids loading rate or minimum hydraulic loading rate dependent on the feed solids concentration, as described below.

B. During the centrifuge performance testing, the County's current polymer product shall be used. As of the writing of this specification, the product in use by the County is Polydyne Clarifloc SE-1080.

C. When high solids centrifuge feed solids concentrations are low, the centrifuge performance shall be governed under the "hydraulic loading limited" operating condition of at least 400 gpm.

D. When centrifuge feed solids concentrations are high, the centrifuge performance shall be governed under the "solids loading limited" operating condition of at least 2,400 dry pounds of solids per hour.

E. When operating in either the "hydraulic loading limited" or "solids loading limited" operating conditions the high solids centrifuge shall be capable of producing the following:

Centrifuge	**Basis of Design**
Number Required	1
Minimum Hydraulic Loading Rate	400 gpm
Minimum Solids Loading Rate	2,400 dry lb/hour
Minimum Dewatered Cake Solids	20.0% TS
Minimum Capture Efficiency	95%
Maximum Polymer Dose	30 lb active/dry ton of solids

1.04 PROCESS PERFORMANCE - LIQUIDATED DAMAGES

A. Failure of the equipment to fully satisfy the guaranteed performance requirements listed in Section 1.03 shall result in a continuation of the performance testing period (after corrective modifications and adjustment to the equipment have been completed). Continued performance testing shall be conducted at the expense of the Centrifuge Manufacturer. Failure to meet all the performance requirements within the specified time limit shall result in the Centrifuge Manufacturer replacing all the equipment as necessary to meet the performance criteria and any structural, electrical, instrumentation or piping modifications required for the new equipment.

1.05 SUBMITTALS

A. The performance affidavit, shop drawings, descriptive data, performance characteristics, material specifications, piping and wiring diagrams showing conformance of all equipment to the Specifications shall be submitted to the Engineer for his review according to the requirements listed herein. Shop drawing submittals shall be furnished as specified in Section 11000, Equipment General Provisions and Section 01300, Submittals.

B. The shop drawing submittals shall conform to the following requirements:

1. Where the manufacturer's publications in the form of catalogs, brochures, illustrations, or other data sheets are submitted in conjunction with prepared shop drawings, such submission shall specifically indicate the item for which approval

is requested. Identification of these items shall be made in ink. Submissions showing only general information are not acceptable.

2. The Centrifuge Manufacturer shall prepare and submit process and instrumentation diagrams in accordance with ISA format and interconnecting wiring and control ladder diagrams in accordance with JIC format for all equipment, instruments, control panels, etc., furnished under this section, and for all instruments and controls for which functional descriptions are provided.

3. All submittals shall be neatly bound, dated, properly labeled. Each part of the submittal shall be marked and tabulated with a table of contents summarizing the information provided in each tabbed section of the submittal. Each submittal, as described below, shall be submitted as a single complete package and shall include all the information requested in the submittal.

4. All submittals shall be provided in the English language.

C. The following detailed submittal information shall be provided to evaluate compliance with the requirements of these specifications:

1. Manufacturer's statement listing specific exceptions taken, or deviations, from the requirements of this specification. Exceptions and deviations taken shall be referenced to the applicable section of the specifications.

2. Manufacturer's warranty statements for the "General Equipment Warranty" and for the "Abrasion Protection System Warranty".

3. Complete dimensional drawings, to scale, of the proposed equipment, including ancillary equipment, to be furnished under this Specification. Drawings and submittal information shall include materials of construction specifications, equipment wet and dry weights, dynamic loadings, minimum clearances required for equipment access and maintenance, foundation and support locations, locations of piping and electrical connections.

4. Process and Instrument Diagrams (P&IDs) for the centrifuge and related equipment. P&IDs shall adequately describe the process equipment, associated instrumentations and control systems. A detailed submittal of the PLC logic programming (documented and annotated) for the PLC to be furnished in the Centrifuge Control Panel (CCP) and for the interface between the CCP-PLC and the plant SCADA system. Submit a SCADA communication table with all variables to be accessed by plant SCADA. Submit color printouts of all operator interface graphics on 8 ½" by 11" paper and in electronic PDF format.

5. Control system catalog information for all components that make up the CCP and field control elements provided under this section, including solenoid valves and pressure, level, temperature, optical, proximity, and vibration sensors and/or switches.

6. Design Data Sheets for the Main (Bowl) Drive and Secondary (Scroll) Drive.

7. Design Data Sheets for the Main (Bowl) Drive and Secondary (Scroll) Drive sheaves and belts.

8. Design Data Sheets for the centrifuge bearings.

9. Design Data Sheets for the vibration isolation system including vibration isolation system design calculations.

10. Catalog information and complete dimensional drawings for the diverter gate, air/lube control system, the air compressor system, and the booster pump(s) supplied.

11. Wiring diagrams including point-to-point wiring and control diagrams, outline drawings showing field wiring, requirements for conduit location and stubups. The physical location of the electrical devices on the centrifuge and its ancillary equipment shall be shown on these drawings. These drawings shall be made specifically for this project. Standard, marked-up drawings shall be rejected. Wiring instructions shall be in English, and electrical connections shall be in accordance with NEMA and ANSI standards. Additional information specified as required for the electrical and control systems elsewhere in this Section shall also be submitted.

12. Detailed parts listing and bill of materials for all equipment furnished by the Centrifuge Manufacturer under this Section. The parts listing shall include parts pricing for all OEM (fabricated by or exclusively available from the Centrifuge Manufacturer) part. Pricing to be firm for 18-months from date of delivery of the equipment to the project site.

13. Detailed listing of the spare parts to be furnished by the Centrifuge Manufacturer under this Section. This listing shall also include a list of special tools (and tool sets) to be provided under this Section required to disassemble, service, repair and/or adjust the high solids centrifuge equipment.

14. Detailed lubrication schedule for the equipment furnished by the Centrifuge Manufacturer under this Section. For each type of lubricant at least two Manufacturers and standard products that can be used interchangeably shall be listed. Where seasonal lubricant grades are recommended these shall be noted for winter and summer conditions.

15. Complete product data sheets for all electrical components and equipment. Electrical components and equipment submittals shall include electrical ratings (voltage, current, KVA, phase, etc.).

16. Test procedures for all Centrifuge Manufacturer shop testing as required elsewhere in these Specifications. The Centrifuge Manufacturer shall submit shop test reports separately following satisfactory shop testing. Shop testing reports shall include, in addition to shop testing results, certificates of calibration for all instruments used to generate the shop testing report results.

17. Data sheets and information related to the Centrifuge Manufacturer's shop priming and painting of surfaces coated prior to shipment to the project site.

Instructions and requirements to the Contractor for field applied paintings and coatings.

18. Centrifuge Manufacturer's instructions to the Contractor for the delivery, unloading, storage, handling and installation of all equipment to be provided by the Centrifuge Manufacturer under this Section.

D. Copies of the Operation and Maintenance Manual (Owner's Manual) shall be provided by the equipment manufacturer prior to shipment of the equipment from the factory to the project site. Manuals that describe general information on the manufacturer's complete line of equipment will not be acceptable. The Operation and Maintenance Manual shall include:

1. Conform to the requirements of Specification 01300.

2. Copies of the approved shop and installation drawings.

3. All necessary information on support and drive equipment such as couplings, speed reducers, motors, etc.

4. An illustrated spare parts breakdown on all component equipment items and the manufacturer's recommended spare parts listing.

5. Dimensional data for items readily manufactured or required locally from a competent machine shop such as shafts, bearings, etc., shall be provided.

6. A detailed summary of manufacturer's recommended maintenance and lubrication requirements shall be provided for each individual piece of equipment, including all component parts which may require routine servicing or lubrication. The lubrication schedule shall include a detailed lubricant specification on the recommended lubricants (as to grade and type) for use with the dewatering equipment.

7. Detailed instructions concerning tests for process troubleshooting, optimization and operation and maintenance training shall be included.

1.06 MANUFACTURER'S GENERAL EQUIPMENT WARRANTY

A. The Centrifuge Manufacturer shall provide a general warranty, in writing, for the equipment furnished under this Section, with exception of the bowl and scroll items described below, against defects in workmanship and material for a period of twenty four (24) months from the date of shipment; or eighteen (18) months from successful completion of performance testing and subsequent acceptance by the County, whichever results in the earliest warranty expiration date. All costs for labor and replacement parts required to repair the units due to equipment malfunction during the warranty period will be considered to have been included in the quoted price for this equipment.

1.07 MANUFACTURER'S ABRASION PROTECTION SYSTEM WARRANTY

A. In addition to the general warranty described above the Centrifuge Manufacturer shall provide a warranty, in writing, for equipment defects and wear on the abrasion resistant protection systems components, as follows:

1. Scroll Conveyor Tiles – 15,000 hours or 3-years (whichever occurs first)

2. Cake Discharge Ports - 15,000 hours or 3-years (whichever occurs first)

3. Centrifuge Bowl - 25,000 hours or 3-years (whichever occurs first)

B. The maximum acceptable conveyor tile abrasion protection loss after 15,000 operating hours shall be three (3) cubic millimeters when tested in accordance with ASTM G-65, Procedure A.

C. The Centrifuge Manufacturer shall provide the services of at least one (1) technical representative to inspect and oversee the disassembly and inspection of the centrifuge at a 5,000-hour, or 12-months, operation service interval, whichever occurs first. Disassembly work will be performed by County under the general oversight of the Centrifuge Manufacturer's technical representative. The service interval time shall be measured beginning on the date when County takes acceptance of the work. The County shall provide all labor, tools and incidentals to inspect the centrifuges.

D. The Centrifuge Manufacturer shall provide the services of at least one (1) technical representative to inspect and oversee the disassembly and inspection of the centrifuge at a 10,000-hour, or 24-months, operation service interval, whichever occurs first. Disassembly work will be performed by County under the general oversight of the Centrifuge Manufacturer's technical representative. The service interval time shall be measured beginning on the date when County takes acceptance of the work. The County shall provide all labor, tools and incidentals to inspect the centrifuges.

E. The Centrifuge Manufacturer's technical representative shall submit a report documenting the findings, including the type, extent and rate of wear for both of the service interval visits. The report shall clearly indicate the amount of wear observed at the service interval and shall estimate the time at which the replacement of the abrasion protection system (scroll or cake discharge ports) or bowl would be required. If the sum of the time in service since equipment start-up plus the estimated remaining life of the conveyor tile and/or cake discharge port abrasion protection system is less than 15,000 operating hours, the Centrifuge Manufacturer shall replace the system either immediately or at the end of the useful life as directed by the County and at no cost to the County. If the sum of the time in service since equipment start-up plus the estimated remaining life of the bowl is less than 25,000 operating hours, the Centrifuge Manufacturer shall replace the bowl either immediately, or at the end of the useful life as directed by the County and at no cost to the County.

F. Any repairs to equipment performed during the warranty period shall be include required re-balancing.

1.08 REFERENCED CODES AND STANDARDS

A. The centrifuge and ancillary equipment shall be designed and manufactured in accordance with the following listed Standards and Specifications, including applicable addenda in effect as of the date of bid submission. They shall be considered an integral part of this specification and shall govern the design, fabrication, testing and inspection of equipment, except as otherwise shown or specified herein.

1. American Gear Manufacturers Association (AGMA)
2. American Welding Society (AWS) D1.1-82, Structural Welding, and ASME, Boilers and Pressure Vessels.
3. Deutsches Institut fur Normung (DIN), if applicable.
4. Verein Deutsche Inginieure (VDI), if applicable.
5. National Electrical Manufacturers Association (NEMA)
6. Anti-Friction Bearing Manufacturers Association (AFBMA)
7. American National Standards Institute (ANSI)
8. National Fire Protection Association (NFPA)
9. Joint Industrial Council (JIC)
10. American Society of Mechanical Engineers (ASME)
11. Underwriters Laboratories Inc. (UL)
12. Institute of Electrical and Electronics Engineers (IEEE)
13. American Society for Testing Materials (ASTM)
14. American Institute of Steel Construction (AISC)
15. National Electrical Code (NFPA-70/NEC)
16. Occupational Safety and Health Administration (OSHA)

1.09 DEFINITIONS

A. SOLIDS CAPTURE EFFICENCY (SCE): The percentage of the feed solids that remain in the dewatered end product on a dry weight basis. For the purposes of this specification, “SOLIDS CAPTURE EFFICENCY” is defined as:

$$SCE = \left(\frac{C}{F}\right) \times \left[\frac{F - E}{C - E}\right] \times 100$$

Where:

C = Dewatered Sludge Cake Total Solids Concentration (mg/L)

F = Sludge Feed Total Suspended Solids Concentration (mg/L) excluding dilution by conditioning polymer solution

E = Centrate Total Suspended Solids Concentration (mg/L) excluding dilution by conditioning polymer solution

B. FEED SOLIDS LOADING (FSL): The mass of dry solids fed to the centrifuge excluding polymer solids added for conditioning expressed in units of dry pounds per hour. For the purposes of this specification, "FEED SOLIDS LOADING" is defined as:

$$FSL = \frac{QS \times FSS \times 60 \times 8.34}{100}$$

Where:

QS = Sludge Feed Flow (gpm)

FSS = Sludge Feed Suspended Solids Concentration (%)

C. DEWATERED CAKE SOLIDS CONTENT: The fraction of dry solid material contained in the dewatered sludge cake. The dewatered cake solids content shall be determined using conventional gravimetric techniques as described in Method 2540G of the 18th edition of Standard Methods for the Examination of Water and Wastewater (APHA, 1992).

D. POLYMER DOSAGE (PD): The polymer dosage is the quantity (pounds) of active polymer solids required to condition and dewater a dry ton of sludge solids. For the purposes of this specification, "POLYMER DOSAGE" is defined as:

$$PD = \frac{(QP \times 60 \times 8.34 \times PS) \div 100}{FSL \div 2000}$$

Where:

QP = Polymer Solution Flow (gpm)

PS = Polymer Solution Active Solids Concentration (%)

E. G-VOLUME (GVOL): The G-volume is a function of the operating g-force measured at the bowl wall and the annular section within the centrifuge and is expressed in units of "G-gallons". For the purposes of this specification, "G-VOLUME" is defined as:

$$GVOL = KW^2 D_b L(D_b^2 - D_d^2)$$

Where:

K = constant (4.83×10^{-8})

W = operating speed (rpm)

L = cylindrical (straight shell) length of bowl (inches)

D_b = bowl diameter (inches)

D_d = cake discharge diameter (inches)

PART 2 – PRODUCTS

2.01 GENERAL

A. The high solids centrifuge shall be of the continuous feed, solid-bowl type with a horizontal scroll conveyor suitable for dewatering the sludge described above and shall be fully suitable for continuous or intermittent operation.

B. For centrifuge equipment installed at the Fiesta Village WRF, the high solids centrifuge shall be designed to allow vertical removal of the bowl and scroll assembly from the centrifuge frame (no lateral movement of the bowl and scroll required for removal) using an overhead 8-ton bridge crane and shall not require more than 6'-0" of height from the bottom of the centrifuge support legs to remove the scroll assembly and move it laterally away from the centrifuge.

C. The high solids centrifuge shall be dynamically balanced prior to shipment from the manufacturing facility and shall be designed such that the operating noise level will not exceed 89 dB at a distance of three (3) feet from the centrifuge. Centrifuge noise levels shall be measured at the factory with all inlet and outlet openings closed and without running process liquids. Certified factory noise testing results shall be submitted prior to shipment of the centrifuge from the manufacturing facility.

D. All parts of the centrifuges in contact with process materials shall be of minimum Type 316stainless steel, except O-rings, lip seals, or abrasion resistant materials, except as specifically allowed otherwise within these Specifications. The O-rings and lip seals shall be of Viton rubber.

E. The following high solids centrifuge equipment manufacturer and model will be accepted for this project:

1. Centrisys, CS 26-4

2. Or Approved Equal

2.02 BASE-FRAME ASSEMBLY

A. The base-frame assembly shall rigidly support the centrifuge bowl and drive assemblies and shall be furnished with lifting eyes, or other facilities, which will permit the lifting of the entire assembled centrifuge unit.

B. The base-frame assembly shall be fabricated from carbon steel and mounted on vibration isolators. The vibration isolators shall be designed to isolate the centrifuge frame from the building structure and shall be specifically sized, depending on bowl speed and other operating conditions, to have a minimum dampening effect of 98 percent of all vibration loads in all directions. Total vibration expectation shall be less than 7 mm/sec.

C. Machined surfaces shall be provided at all points where support loads are transferred to the base-frame assembly.

2.03 CENTRIFUGE BOWL

A. The centrifuge bowl shall consist of a horizontal, centrifugally cast cylindrical bowl with a conical beach extension in which a scroll conveyor fits concentrically. The minimum inside diameter of the centrifuge bowl shall be 25.5 inches. Centrifuge bowls fabricated from rolled and welded steel will not be acceptable. The bowl shell shall be designed to withstand all centrifugal forces encountered at the maximum operating speed with appropriate safety factors. Maximum bowl speed shall be not greater than 3,600 rpm, driven by a maximum 125-hp main drive, producing a gravitational force of no more than 3,000-G's. The calculated G-volume must be equal to, or greater than, 400,000 G-gallons. The cylindrical bowl section shall have a minimum length-to-diameter ratio of 4:1. The bowl shall have a maximum beach angle of 15 degrees.

B. Notwithstanding the minimum requirements for gravitational force, G-Volume, or bowl length-to-diameter ratio, the Centrifuge Manufacturer shall not be relieved of achieving the specified performance requirements.

C. The bowl wall shall be protected by longitudinal wear strips, which cause a protective layer of solids between the bowl wall and the scroll conveyor for abrasion protection.

D. Cylindrical and conical sections of the bowl shall have a minimum thickness of 0.9 inches and shall be manufactured from castings of duplex stainless steel. All centrifugal castings shall be inspected for cracks, shrinkage, porosity or other defects, by means of liquid dye penetrate test. The centrifuge bowl shall be centrifugally cast from duplex stainless steel; with a minimum tensile strength of 100,000 PSI (690MPa) Material shall be A890 or 1.4470. The two bowl hubs shall be cast of stainless steel of equal or higher grade than the cylindrical and conical bowl sections. Not withstanding the minimum bowl thickness stated above, the Centrifuge Manufacturer shall provide material thicknesses in the bowl body (bowl and end hubs) as required such that the bowl body shall be designed to withstand all static and dynamic forces encountered at the maximum operating speed with appropriate design safety factors.

E. The pond depth in the centrifuge bowl shall be adjustable through the use of weir plate dams located at the large diameter end of the centrifuge bowl where the centrate is discharged. The weir plate dams shall be adjustable without removing the bowl assembly from the base-frame assembly. Dewatered cake solids shall be discharged from the smaller diameter end of the centrifuge bowl, opposite the centrate discharge.

F. The dewatered solids shall be discharged from the bowl via a number of solids discharge ports. The solids discharge ports shall be protected by field replaceable tungsten carbide wear nozzles.

G. Sludge feed shall be introduced into the centrifuge feed zone by means of a 2.5-inch diameter 304L stainless steel feed pipe from the solids end. The liquid end feed design is not acceptable. The feed shall be uniformly distributed into the centrifuge and the feed zone.

H. The bowl shall be supported on the main frame by sealed bearings that shall be forced oil system lubricated. External forced oil lubrication units and/or grease lubrication fittings shall be readily accessible without having to dismantle or disassemble the centrifuge.

I. All surfaces of the bowl shall be examined for cracks, shrinkage, porosity, or other defects by means of a liquid dye penetrant test. Certified test reports shall be submitted by the Centrifuge Manufacturer prior to shipment of the centrifuge to the job site.

2.04 HORIZONTAL SCROLL CONVEYOR

A. Each centrifuge shall be equipped with a horizontally mounted, cylindrical-conical scroll conveyor mounted concentrically within the centrifuge bowl. The scroll conveyor shall have helical flights mounted on a central shaft. The scroll conveyor shall utilize differential speed operation to convey solids from the cylindrical and conical sections of the bowl to the solids discharge port with minimal disturbance to the liquid pool.

B. The scroll shall be supported on the main frame by sealed bearings that shall be grease lubricated. External grease lubrication fittings shall be readily accessible without having to dismantle or disassemble the centrifuge. All grease fittings shall be uniform type and shall be serviceable by a single type of grease gun.

C. The horizontal scroll conveyor shall be manufactured of type 316, or higher grade, stainless steel and shall be equipped with an abrasion protection system. The scroll conveyor feed zone shall be coated with a field-replaceable flame-sprayed tungsten carbide coating on all the wearing surfaces. Field replaceable sintered tungsten carbide tile assemblies from the feed zone to the conveyor solids discharge zone shall protect the edge and face of the conveyor flights. The tiles shall be affixed to the flights by welding. Wear tile hardness shall exceed 1600 Vickers hardness.

D. The maximum acceptable abrasion protection system loss for the wearing tips and flame applied material shall be three (3) cubic millimeters when tested in accordance with ASTM G-65, Procedure A. The scroll and/or tiles shall be provided with wear indicators such as lines or drilled holes, or other means, to allow visual inspection of wear for purposes of establishing compliance with the wear and abrasion resistance guarantee.

E. Each scroll shall be independently balanced at full operational speeds prior to shipment to the job site. The Centrifuge Manufacturer shall submit certified test reports prior to shipment.

F. All surfaces of the scroll shall be examined for cracks, shrinkage, porosity, or other defects by means of a liquid dye penetrant test. Certified test reports shall be submitted by the Centrifuge Manufacturer prior to shipment of the centrifuge to the job site.

2.05 FEED TUBE, FEED COMPARTMENT AND FEED PORTS

A. The centrifuge feed tube shall be manufactured of type 316, or higher grade, stainless steel. The centrifuge feed compartment shall be manufactured of type 316, or higher grade, stainless steel.

B. The feed tube assembly shall also provide a triple tap connection, external to the centrifuge, for the feed solids slurry, dilute polymer solution conditioning agent, and flushing water connections.

C. The feed tube and feed compartment shall be designed to evenly distribute the centrifuge feed within feed chamber area to the centrifuge bowl.

D. The centrifuge feed chamber shall have a minimum of 16 feed ports with no less than 165 in^2 of area. Feed ports shall be protected from abrasion wear by a flame-sprayed tungsten carbide hard surfacing. Feed ports shall be abrasion protected by replaceable liners of solid sintered tungsten carbide or flame-sprayed tungsten carbide stainless steel. Feed ports shall be field replaceable.

2.06 BEARINGS AND OIL LUBRICATION SYSTEM

A. The main bowl and conveyor scroll bearings shall have an ABMA L-10 rating, without adjustment factors, of not less than 100,000 hours at twenty-four (24) hours per day service at the specified operating conditions.

B. The pillow block bearings shall include lifting eyes and shall be designed as to allow easy access to the bearings for inspection and maintenance purposes. All special tools, if any, necessary for inspection or maintenance of the bearing assemblies shall be furnished as part of the centrifuge supply.

C. The main pillow block bearings shall be forced oil lubricated, protected by seals, and equipped with external grease/oil lines mounted to the centrifuge frame. The pre-piped, external manual greasing/oil system shall be designed such that the centrifuge covers do not need to be removed for proper lubrication at the bearings.

D. Conveyor bearings shall be ball or roller bearings, grease or forced oil lubricated, protected by seals.

E. Bearings shall be oil lubricated if the bearing speed exceeds 150,000 DN.

F. The forced oil lubrication system shall include an air/oil lubrication panel, which shall include the oil circulation pump, conduit and wire for the system, air pressure regulator, mist separator, pressure switch, solenoid valve and switches, drain for the oil cooling heat exchanger, an appropriately sized compressor to provide compressed air, and any other requirements of the forced oil lubrication system.

1. The forced oil lubrication system shall be an Oil Streak Systems™ Air/Oil Lubrication Systems from Bijur Delimon International which shall be provided to deliver high-efficiency lubrication and cooling for high-speed spindles and other surfaces requiring accurate oil deliveries. Air/oil lubrication shall allow for minimal lubricant delivery on a continuous basis, reducing oil consumption and keeping the bearing surface clean and free of contaminants. The design shall deliver precise amounts of lubricant and shall eliminate residual drift of oil fog or mist during operation, reducing contamination.

2. The system shall utilize a specially-designed positive displacement injector (PDI) with oil outputs to a close tolerance level down to 0.01cc/cycle to permit exact oil volumes to be discharged into an air mixing valve discharged through clear plastic tubing to critical bearing points.

3. The compressor shall be a Quincy QT Pro, 3 phase/480V with motor overload protection and automatic start/stop. Unit shall include vertical compressed air tank with compressor mounted on top. Minimum HP of unit shall be 7.5 HP. Tank shall be constructed of cast iron and shall be ASME rated for 200 psig with ASME coded relief valves at inter-stage and discharge. Compressor shall be splash lubricated, two stage unit and shall include inlet filter/silencer, stainless steel reed valves, ductile iron double throw crankshaft, and fin and tube intercooler.

4. The compressor system shall be utilized and properly sized for the purposes required of the forced lubrication system. Sizing of the compressor system shall be verified by the centrifuge manufacturer for the loads required.

5. The forced lubrication system controls shall include solenoid valves and sensors to provide interface with the CCP for the following signals:
   a. 120V power to and control of the air supply solenoid from the system
   b. 120V power to and control of the oil supply solenoid from the system
   c. Low air pressure switch and associated alarm signal
   d. Low oil pressure switch and associated alarm signal
   e. Low oil level switch and associated alarm signal

6. The air compressor system shall be a self-contained system with integral controls and pressure switches to maintain a constant and reliable air supply at the operating range of pressure, nominally 60-80 psi or higher if required. The control system shall be powered from the motor control center (MCC) provided under Division 16 and provide feedback to the CCP for:
   a. Compressor running
   b. System fault
   c. System in Auto

7. Wiring and conduit between the lubrication system and the CCP, as well as between the air compressor control panel and the CCP, shall be supplied and furnished under Division 16. Contractor shall coordinate between the centrifuge manufacturer and the Division 16 electrical subcontractor to provide the appropriate number, size, and type of wire required for the needed wiring interface.

2.07 CENTRIFUGE ENCLOSURE (UPPER AND LOWER CASING)

A. The high solids centrifuge shall be furnished with an enclosure system consisting of both an upper and lower casing mounted to the centrifuge base frame assembly. The upper casing shall be removable to allow removal of the bowl and scroll assembly from the base frame. The lower casing shall be fixed to the base frame assembly and shall be provided with flanged discharge connections for the centrate and solids discharge chutes. The upper and lower casings shall contain and drive the liquid and dewatered cake discharges, respectively, to the centrate and solids discharge chutes.

B. The upper and lower casings shall also provide noise protection and odor containment for the high solids centrifuge.

C. The upper casing shall be provided with lifting eyes, or lifting lugs, for removal of the upper casing from the centrifuge main frame by the overhead hoist or in the case of a side removal, the Centrifuge Manufacturer shall provide lifting connections for the scroll to facilitate easy removal.

D. The upper casing shall be provided with inspection ports, or openings, at each end of the high solids centrifuge. The inspection ports, or openings, shall be of sufficient size to allow inspection, cleaning and internal adjustments (including inspection and removal of the weir plates on the liquid discharge end) to be made without removal of the upper casing from the centrifuge main frame.

E. The upper casing shall consist of a type 316, or higher grade stainless steel, protective inner shell where required for structural or abrasion and/or corrosion protection. The stainless steel liner inner shell shall be provided in the upper casing, at a minimum, at the centrate and solids discharge wells. The inner liner shall be designed to resist abrasion and prevent direct contact of the centrate and dewatered solids with the outer FRP shell. The inner stainless steel shell shall have a minimum thickness of 0.5 inches and shall be coated with a tungsten-carbide coating for abrasion resistance.

F. The lower casing shall be manufactured of Type 316, or higher grade, stainless steel and shall be coated with a tungsten-carbide coating for abrasion resistance in the solids discharge zones. The lower casing shall be provided with flanged connections for the liquid and solids discharge chutes.

2.08 SOLIDS AND CENTRATE DISCHARGE CHUTES

A. The centrifuge shall be provided with stainless steel centrate and solids discharge chute extensions connected to the casing flange of the centrifuge. A flexible connector shall be installed between the chutes and the casing flange of the centrifuge.

B. The centrate discharge chute shall be provided with a 2-inch (minimum) diameter centrate sampling port with a flanged flexible connector. The cake discharge chute shall be provided with a 2-inch minimum diameter cake sampling port.

C. The flanged discharge extension and the flexible connector shall be supported from the centrifuge floor.

D. In order to guarantee water tightness, plate junctures of the discharge extension shall be continuous seal welded inside and outside. Stiffeners, adequate in size, number and configuration, shall be provided to achieve mechanical sturdiness for shipment, installation and operation.

E. The centrate and solids discharge chute extensions shall be of at least Type 304 stainless steel of minimum gauge 10 thickness. All associated hardware shall be at least Type 304 stainless steel. Gaskets shall be neoprene.

F. Solids discharge chute extension connections shall be coordinated by the Contractor with the manufacturers of the high solids centrifuge and dewatered cake screw conveyance equipment.

G. Discharge chutes shall be provided with watertight NPT connections for spray nozzles.

H. Discharge chute shall be provided with diverter slide gate to allow diversion of “slop” to the system drain and away from the truck loading conveyor during system startup, shutdown, and cleaning modes. Diverter slide gate, including the 120V electric gate actuator shall be supplied with the centrifuge under this Section and shall meet all the requirements of Section 15207.

2.09 MAIN BOWL DRIVE SYSTEM

A. Each centrifuge shall be equipped with a main drive system for rotating the centrifuge bowl assembly. The main drive system shall consist of a motor base, V-belt drive, electric motor and variable frequency drive (VFD) and related appurtenances.

B. The motor base shall be of the sliding adjustable type with jacking screws to permit movement of the motor for tensioning the belts or changing sheaves and belts, without the need to realign the motor following these operations.

C. The belt drive system shall consist of multiple belts and sheaves sized to provide the full load capacity for the centrifuge. The belt drive system shall be capable of withstanding the centrifuge full load starting torque. Motor belt and sheave sizes shall be as selected by the Centrifuge Manufacturer. Belt drive shall have a minimum service factor of 1.7 based on the belt manufacturer’s rating.

D. The variable frequency drive supplied for the main bowl drive shall conform to the requirements specified in Section 16165 – Variable Frequency Drive Systems. This includes but is not limited to meeting the harmonic distortion requirements as defined in IEEE 519.

E. The main drive system electric motor shall be rated for continuous duty and have a horsepower and torque output adequate for all operating conditions, including maximum bowl speed and sludge feed rate, but not exceeding 125-HP. The motor service factor shall not be used to determine a non-overloaded operating condition.

F. The motor, when operating at an ambient temperature not to exceed 104°F (40°C), shall be capable of making two complete starts in succession with coasting to a rest between start attempts. The motor shall be capable of at least one restart within one hour following any shutdown.

G. The motor shall take no longer than ten (10) minutes to accelerate the centrifuge to full operating speed using the variable frequency drive when operating at 90% of the nameplate voltage.

H. The main drive electric motor shall have the following characteristics:

1. Inverter Duty Classification
2. Continuous Duty Classification
3. High Efficiency Design
4. Horizontal, Squirrel Cage Induction Type
5. NEMA frame motor

6. 3,600 RPM synchronous speed
7. 460 volt, 3-phase, 60 hertz power supply
8. TEFC or TEBC enclosure
9. Service Factor = 1.15
10. Class H insulation
11. Corrosion resistant enclosure
12. Condensate drain
13. Gasketed, stainless steel terminal boxes
14. Maximum Sound Level: 89 dBA at 3 feet
15. Stainless steel nameplate
16. Motor winding RTDs
17. Integral 120V space heater to prevent internal condensation when the motor is not running
18. High Power Factor
19. Motor bearing life of 100,000 hrs

2.10 HORIZONTAL SCROLL (BACKDRIVE) SYSTEM

A. Each centrifuge shall be equipped with a hydraulic backdrive system to allow adjustment of the differential speed between the centrifuge bowl and the scroll conveyor during operation of the centrifuge unit.

B. The backdrive motor shall have the following characteristics:

1. Continuous Duty Classification
2. High Efficiency Design
3. Horizontal, Squirrel Cage Induction Type
4. NEMA frame motor
5. 3,600 RPM synchronous speed
6. 460 volt, 3-phase, 60 hertz power supply
7. TEFC or TEBC enclosure
8. Service Factor = 1.15
9. Class H insulation
10. Corrosion resistant enclosure
11. Condensate drain
12. Gasketed, stainless steel terminal boxes
13. Low noise design
14. Stainless steel nameplate

15. Motor winding RTDs

16. Integral 120V space heater to prevent internal condensation when the motor is not running

17. Motor bearing life of 100,000 hrs.

18. High Power Factor

C. Hydraulic scroll drive system shall be supplied with the centrifuge to provide speed variation between the conveyor and the bowl. The hydraulic motor shall have a minimum torque of 25,200 Nm.

D. The differential speed between the centrifuge bowl and scroll conveyor shall be produced by a 40-HP (maximum), water cooled hydraulic system which shall independently drive the scroll conveyor. Supplier shall be Visco-therm, or approved equal.

E. The hydraulic scroll conveyor drive system shall be designed such that no mechanical gear reducer is used in the scroll conveyor drive train

F. In the automatic mode it shall continuously monitor changes in internal torque created by variations in influent feed solids and automatically maintain a preset torque input to the scroll by allowing the differential speed to vary. The hydraulic drive shall operate in a manner such that, as the reactive torque of scroll shaft increases due to an increase in solids inventory in the bowl, the scroll differential speed shall gradually increase and, conversely, as the inventory of solids in the bowl and resultant reactive torque decreases, the scroll differential speed shall decrease. The net effect of this system, when operated in the automatic mode, shall be to maximize the time that cake solids are under the influence of accelerated gravitational force to ensure that the driest possible dewatered cake product is produced without plugging the centrifuge.

G. The system shall use a hydraulic pumping group and hydraulic motor. Torque-based adjustment shall be a function of input to the driven unit. The maximum torque input and rate of change of scroll differential speed shall be adjustable.

H. The system shall be designed such that automatic centrifuge shutdown is initiated in the event that excessive torque is detected.

I. In the event that torque exceeds the normal operating range, the sludge feed pump and associated grinder shall be automatically stopped to allow the centrifuge to clear itself and shall automatically restart when the torque drops to the normal operating range. In the event that the torque approaches the limit of the drive, a second set of contacts shall automatically initiate shutdown of both the feed pump and centrifuge. In this instance manual reset of the hydraulic drive shall be required before the centrifuge can be restarted.

J. Upon being energized, a cooling water solenoid shall engage to allow cooling of the hydraulic oils. Should no water pressure be available, the system shall not be allowed to start. Control of the 120V solenoid shall be through the CCP.

K. Backdrive Controls Junction Box: The centrifuge shall include a NEMA 4X, Type 316 stainless steel or aluminum terminal junction box to receive signals from sensors mounted on the backdrive system on the centrifuge and transmit the signals to the CCP. Junction box signals shall be factory pre-wired to the field sensors. Signal interface between the junction box and the CCP shall include:

1. Proportional valve control, 3W 24Vdc
2. Oil temperature and level, 3W 24Vdc (2 sensors, one signal to CCP)
3. Hydraulic oil pressure, 2W 24Vdc signal

Wiring and conduit between the backdrive controls junction box and the CCP shall be supplied and furnished under Division 16. Contractor shall coordinate between the centrifuge manufacturer and the Division 16 electrical subcontractor to provide the appropriate number, size, and type of wire required for the needed wiring interface.

2.11 VIBRATION CONTROL AND MONITORING SYSTEM

A. Rotating assemblies shall be dynamically balanced before the system shop tests are accomplished. The bowl and conveyor assemblies shall be independently balanced. During system shop testing the vertical, horizontal and axial components of self-excited vibrations, measured at either bearing, and expressed in terms of "vibration velocity" shall not exceed the magnitude of 0.28 inch/sec, equivalent to 7 mm/sec. root mean square (RMS), when measured at both main bearings in the vertical, horizontal and axial directions. This limit shall not be exceeded both with and without feed, and over the full expected range of differential speeds. Results of the system shop vibration and balancing testing shall be provided prior to shipment of the high solids centrifuge equipment from the assembly shop.

B. Vibration Sensors and Monitors

1. Each centrifuge shall be provided with two solid state sensing devices permanently mounted on the pillow block of the main bearing on the drive end of the centrifuge. These sensors shall monitor the transverse components (horizontal and vertical) of the vibrations at that bearing. The signals from the two sensors shall be wired to the centrifuge control panel through the centrifuge controls junction box.

2. Vibration sensors shall be IMI Vibration Sensors by PCB Piezotronics, or equal.

3. Vibration monitors shall be Model No. XM120 as manufactured by Entek or equal. The Centrifuge Manufacturer may opt to connect the vibration sensor directly to the PLC eliminating the vibration monitor. The Centrifuge Manufacturer shall be responsible for coordination of signal requirements and provide I/O cards to accept the vibration sensor signal. All functionality associated with the specified monitor shall be displayed via the OWT on the CCP.

C. Vibration Isolators

1. The centrifuge (and the main drive motor, if mounted on a separate base) shall be mounted on vibration isolators. The number, capacity and vibration constant

of the isolators shall be as recommended by the isolator manufacturer for the load and impact resulting from the operation of the centrifuges. Isolators shall be designed to control oscillation and withstand lateral forces in all directions.

2. Each isolator shall be provided with built in leveling bolts and shocks to control oscillation and withstand lateral forces in all directions. Isolators shall be self-leveling or designed for internal leveling and adjustment.

D. Centrifuge Controls Junction Box: The centrifuge shall include a NEMA 4X, Type 316 stainless steel or aluminum terminal junction box to receive signals from sensors mounted on the unit and transmit the signals to the CCP. Junction box shall be mounted to the centrifuge and be factory pre-wired to the field sensors. Signal interface between the junction box and the CCP shall include:

4. Main drive speed proximity switch, 3W pulse signal, 24Vdc
5. Backdrive speed proximity switch, 3W pulse signal, 24Vdc
6. Main drive optical speed sensor, 3W 24Vdc signal
7. Back drive optical speed sensor, 3W 24Vdc signal
8. Vibration sensor, 2W 24Vdc signal (two sensors, one signal to CCP)
9. Main bearing 1 temperature sensor, 2W 24Vdc signal
10. Main bearing 2 temperature sensor, 2W 24Vdc signal

Wiring and conduit between the centrifuge controls junction box and the CCP shall be supplied and furnished under Division 16. Contractor shall coordinate between the centrifuge manufacturer and the Division 16 electrical subcontractor to provide the appropriate number, size, and type of wire required for the needed wiring interface.

2.12 FLEXIBLE CONNECTORS

A. Transmission of movement and vibrations between interconnecting equipment and structures, piping, conduit, etc. shall be prevented. Flexible connectors shall be provided for, but not limited to, the following:

1. Sludge Feed Piping
2. Polymer Solution Feed Piping
3. Washwater Feed Piping
4. Centrate Discharge Chute Flange Connection
5. Solids Discharge Chute Flange Connection
6. Drain Discharge Connection
7. Power and Control connections

B. Flexible pipe connections shall be flanged units fabricated of elastomer and duck with helical steel wire reinforcing. The elastomer shall be Viton for the polymer solution and Buna-N for sludge; fabric reinforced neoprene is also acceptable. Units shall have integral full-face molded rubber flanges with split, Type 304 stainless steel backup rings rated for 150 psi. Flexible pipe connections shall be maximum 24 inches long face-to-

face. Flexible pipe connecting shall be Style 150R as manufactured by Mercer Rubber Co., Metraflex Co., or equal.

C. The flexible connectors for the centrate and solids chutes shall be of black molded neoprene, 2-ply fabric with polyester cord; the flanges and hardware shall be of Type 316 stainless steel, or greater.

2.13 ANCHOR BOLTS AND FASTENERS

A. All necessary anchor bolts shall be provided by the Contractor. The anchor bolts shall be of Type 304 stainless steel, or greater, with Type 304, or greater, nuts and washers; anchor bolts for the centrifuge shall be not less than 3/4-inch diameter. Number of anchor bolts, diameter, and embedment shall be determined by the Centrifuge Manufacturer. Larger diameter anchor bolts shall be provided if recommended by the Centrifuge Manufacturer. Anchor bolts shall be suitable to anchor the centrifuges to the equipment pads. All anchor bolt threads shall be coated with a nickel bearing anti-seize lubricant at the time of installation. All anchor bolts shall be English (non-metric) dimensions.

B. All internal fasteners supplied with the centrifuge unit, which are subject to contact with any process flow or cake discharge shall be Type 316 stainless steel.

2.14 PROTECTIVE GUARDS

A. Guards meeting local, state and federal safety requirements shall be provided for all gear boxes and belt drives and shall comply, as a minimum, with the following requirements:

1. Shall be designed to minimize noise resulting from their vibrations;

2. Shall be designed for the mechanical protection of the covered equipment;

3. Shall have proper ventilation ports to disperse the heat generated during operation;

4. Shall have minimum 1-inch diameter holes coinciding with the shafts of the enclosed equipment to permit checking the rpm.

B. The belt guards shall be provided with two removable inspection covers to allow belt inspection. These covers shall be located for convenient observation of the belts and checking of belt tension. Covers shall consist of a steel frame and wiremesh panel and shall be bolted in place with stainless steel bolts.

C. Guards shall be constructed of Type 304 stainless steel.

2.15 PAINTING AND COATINGS

A. All carbon steel, cast iron, and ductile iron surfaces shall be painted/coated in accordance with the requirements of Section 09900 and as recommended by the manufacturer.

B. Stainless steel and fiberglass reinforced plastic surfaces do not require painting or coating.

2.16 EQUIPMENT IDENTIFICATION PLATE

A. The centrifuge shall be provided with a substantial stainless steel nameplate, securely fastened to the base or other conspicuous place, and clearly inscribed with the Centrifuge Manufacturer's name, year of manufacture, model number, serial number, and principal rating numbers. This plate shall also carry the project identification number of the unit.

B. The equipment identification plate shall not be covered over by shop or field applied coatings.

2.17 ELECTRICAL EQUIPMENT AND CONTROLS – GENERAL REQUIREMENTS

A. The Centrifuge Manufacturer shall design, furnish, shop test, burn-in and calibrate all instruments, control panels, programmable logic controllers (PLCs), appurtenant equipment and accessories specified herein, or shown on the Drawings for the operation and control of the centrifuge equipment. All ancillary equipment, parts, devices, wiring, and hardware necessary to meet system functional requirements shall be provided.

B. The Centrifuge Manufacturer shall provide a programmable logic controller to control the centrifuge unit including the centrifuge feed pump and associated grinder, washwater system, polymer feed system, and the dewatered screw conveyor. PLC equipment shall be provided complete with rack, power supply, I/O cards, special function cards, instructions, memory, input/output capacity, and appurtenances to provide all features and functions as described herein. Memory and processor shall be adequate for all control functions specified. The centrifuge PLC system shall interface with the existing in-plant PLC-based control system via Ethernet TCP/IP. All equipment status and control bits as well as analog words transmitted to and from the centrifuge PLC system to the FV WRF plant PLC network shall be via the Ethernet network. The centrifuge PLC system shall be compatible with the plant’s supervisory PLC network system and shall conform to the requirements of Division 17.

C. The Centrifuge Manufacturer shall be responsible for coordinating control signal types and transmission requirements between the PLC system and other various parties providing equipment under this Contract. Signal coordination requirements for the PLC system design shall conform to Division 17.

D. The centrifuge PLC processor and I/O assembly shall be located within the Centrifuge Control Panel (CCP) assembly with an operator interface unit for viewing and changing PLC monitoring and control parameters associated with the centrifuge dewatering process. The CCP shall be at the location shown on the Drawings.

E. Instrumentation and control device submittals shall conform to the requirements of Division 1 and shall include a specific data sheet for each device installed, including front panel instruments for which the following information, as a minimum, shall be provided as applicable:

1. Instrument Tag Number

2. Product (Item) Named Herein

3. Name of Manufacturer/Supplier

4. Manufacturer's Complete Model Number

5. Field Location of the Device

6. Input-Output Characteristics

7. Range, Size, and Graduations

8. Physical Size (with Dimensions)

9. NEMA Enclosure Classification

10. Mounting Details

11. Materials of Construction

12. Instrument/Control Device Sizing Calculations (where applicable)

13. Certified Calibration Data

14. Environmental Requirements (Storage and Operation)

F. Tappings and connections for primary process sensors shall be sized to suit each individual installation and the requirements of the instrument served. The location, orientation, and dimensions of the connections and tappings for instrumentation shall provide for the proper bracing, the required accuracy of measurement, protection of the sensor from accidental damage, and accessibility for maintenance while the equipment is in operation. Isolation valves shall be provided at all instrumentation taps, where applicable.

G. All electrical work associated with the panels, instruments, and controls shall be in accordance with the codes specified in Division 16. All electrical work shall be of the same quality and characteristics as that provided under Division 16. All electrical components shall be NEMA rated. IEC rated devices are unacceptable. All circuit breakers shall be fully rated, series rated circuit breakers are unacceptable.

H. All conduit and wiring for devices associated with the system shall be pre-wired by the Centrifuge Manufacturer to integrally mounted junction boxes. Separate junction boxes shall be provided for control and signal wiring, with all wiring identified and brought to numbered terminal strips. All wiring shall be neatly installed in vertical or horizontal runs and shall not interfere with the disassembly and/or hoisting of any system component. All junction boxes shall be NEMA 4X SST. All rigid conduit shall be PVC coated rigid galvanized steel. All flexible conduit shall be liquid-tight flexible metal conduit. The maximum length of liquid-tight flexible metal conduit shall be three feet (3 ft.). All conduit shall be supported as specified in Division 16.

I. The centrifuge control panel doors shall be reinforced as required to support heavy components, to provide rigidity, and to prevent drumming. The structural components shall be sufficiently strong to withstand the load of all devices and appurtenances mounted thereon. Steel angle braces shall be provided for support of deep case instruments and components. Panel construction shall be free from all flaws in fabrication. All exterior seams shall be continuous and all surfaces shall be ground smooth. Particular care shall be taken to provide stress-free front panels where instrument cut-outs will be required such that no distortion will occur when the cutouts are being made.

J. Engraved plastic nameplates shall be mounted on the front and inside of each panel or junction box to designate the unit served and to identify the various indicators, switches, devices, instruments, etc. Nameplates shall have white letters on a black background and be secured with stainless steel screws. Suitable warning labels shall also be included inside of the panel to alert the operator of the presence of live control power and to provide clear disconnection instructions.

K. In addition to the AC safety ground system provided in each panel, a separate grounding system shall be provided for the control system power and logic circuits (i.e., the DC signals). The DC ground bus shall be a separate bare copper ground bus with standoffs for isolation from the cabinet. The DC ground system for the CCP containing digital hardware shall be tied together to ensure a single DC ground potential for the panels. The busses shall be furnished with 10/32 binding head screws for termination of shield drain wires. The DC ground conductor shall be a #1/0 insulated wire run directly from the panels to a separate copper ground rod outside the building.

2.18 CENTRIFUGE CONTROL PANEL (CCP)

A. The Centrifuge Manufacturer shall furnish a CCP for the centrifuge. The CCP shall be located as shown on the Drawings.

B. The CCP shall be a NEMA 12 gasketed freestanding steel cabinet with forced air ventilation. The maximum dimensions of the CCP shall be nominally 36” wide x 20” deep x 72” tall and located as indicated on the Drawings. Panel construction shall be minimum 12-gauge thickness. Ventilation shall occur on the front of the enclosure. Fans shall be designed for an assumed 80°F ambient air temperature in the air-conditioned electrical room. However, all control components within the CCP shall be rated for operation in up to 105°F temperatures (in the event of complete structure air-conditioner failure).

C. Provide a variable frequency drive (VFD) for the main drive. The VFD shall be furnished with the appropriate full load current and overload ratings commensurate with the current ratings of the motors and long acceleration times. The current rating of the VFD shall be 125% (minimum) of the full load current of the motor it is controlling. The VFD shall be supplied with the centrifuge to provide single supplier responsibility. The VFD shall comply with all requirements of Section 16165. The main drive VFD shall be mounted remotely from the CCP with the following signal interface between exterior devices and the VFD:

1. 480V power from the MCC to the VFD
2. 480V power from the VFD to the main drive motor

3. 120V power for the main drive motor space heater from the VFD to the heater in the main drive motor (120V control transformer within the VFD to be sized for operation of the heater).
4. Motor high temperature switch signal from the main drive motor to the VFD
5. In HAND and In REMOTE signals from the Hand/Off/Remote switch mounted near the main drive motor to the VFD.
6. Start command from the CCP to the VFD
7. Motor Running signal from the VFD to the CCP
8. VFD Fault signal from the VFD to the CCP
9. In Local signal from the VFD to the CCP
10. Motor Temperature High signal from the VFD to the CCP
11. VFD Enclosure High Temperature signal from the VFD to the CCP
12. Remote reset from CCP to VFD
13. Speed feedback 4-20mA signal from the VFD to the CCP
14. Motor Current 4-20mA signal from the VFD to the CCP
15. Speed reference command 4-20mA signal from the CCP to the VFD

VFD control wiring shall be as shown on Sheet E-22. Wiring and conduit between the motor and the VFD, between the VFD and the MCC, and between the VFD and the CCP shall be supplied and furnished under Division 16. Contractor shall coordinate between the centrifuge manufacturer and the Division 16 electrical subcontractor to provide the appropriate number, size, and type of wire required for the needed wiring interface.

D. The MCC provided under Division 16 will include a motor starter and 480V power for the hydraulic back drive system. Control of the back drive will be through the CCP with the following interface:
   1. 480V power from the MCC to the backdrive motor
   2. 120V power for the backdrive motor space heater from the MCC to the heater in the backdrive motor
   3. Motor high temperature switch signal from the backdrive motor to the MCC
   4. In HAND and In REMOTE signals from the Hand/Off/Remote switch mounted near the backdrive motor to the MCC
   5. Start command from the CCP to the MCC
   6. Motor Running signal from the MCC to the CCP
   7. Starter fault signal from the MCC to the CCP
   8. In Remote signal from the MCC to the CCP
   9. Motor Temperature High signal from the MCC to the CCP

   Motor starter control wiring shall be as shown on Sheet E-21 as supplied under Division 16 with the MCC. Wiring and conduit between the motor and the MCC and between the MCC and the CCP shall be supplied and furnished under Division 16. Contractor shall

coordinate between the centrifuge manufacturer and the Division 16 electrical subcontractor to provide the appropriate number, size, and type of wire required for the needed wiring interface and to assure the 120V control transformer within the MCC starter cubicle is sized to run the motor space heater provided.

10. The CCP shall operate 120V, single phase, 60-hertz power service. The CCP shall include a main circuit breaker with branch circuit breakers for the panel lighting and receptacle, the panel ventilation, and the panel UPS for the controls.

11. The Centrifuge Manufacturer shall furnish detailed working drawings to the Contractor showing the locations of all field devices, wire sizes, wire quantities, wire color coding, and terminal numbers inside the junction boxes furnished by the Centrifuge Manufacturer. The Centrifuge Manufacturer shall furnish and install terminal strips inside the CCP to allow for the wiring between the cabinet and all outside devices with 20% spare terminals.

12. The Contractor shall furnish, install, terminate, and test wiring in the quantity required for a complete system between the CCP and all exterior devices. The Contractor shall submit copies of the test data to the Engineer prior to centrifuge system start-up.

13. The centrifuge PLC shall communicate with other PLC systems in the FV WRF facility via the plant's fiber optic network. An Ethernet network interface module and fiber optic converter module shall be provided in the centrifuge CCP as required in order to connect the WRF PLC network. The Centrifuge Manufacturer shall provide the information associated with PLC registers, network addresses, and any other information required for a complete and operable centrifuge control system as monitored from the plant SCADA system.

14. The Centrifuge Manufacturer shall provide pre-wired terminals to connect a 120 VAC, 60 Hz, single phase, uninterruptable power supply (UPS) source. The UPS shall be sized and supplied by the Centrifuge Manufacturer. Provide UPS power to critical control components within the CCP to maintain power to the PLC system at all times to prevent control system problems during power outages. Critical field components that might cause restart problems with the centrifuge operation during a power outage shall also be powered through the UPS from the CCP. UPS shall be sized for all connected loads running at 100% load for up to 30 minutes. UPS shall be as supplied by APC, Best, or approved equal. UPS may be located within the CCP if generated heat is sufficiently dissipated by the panel's ventilation system. Otherwise, the UPS is to be mounted adjacent to and external to the CCP on a stainless steel wall mounting bracket supplied with the unit.

15. The CCP shall be completely pre-wired and tested at the factory by the Centrifuge Manufacturer. Instruments, switches, and electronic devices on and within the CCP may be of any standard voltage of the manufacturer's selection, provided that it is fully coordinated by the Centrifuge Manufacturer with all related instruments. The Centrifuge Manufacturer shall be responsible for coordinating all internal panel power supplies and voltages. The manufacturer shall maintain separation of wiring of different voltages within the panel and shall clearly tag and identify all wiring as to voltage and circuit within the panel. Output contacts in the panel that are powered from other locations shall be provided with special tags and/or color-coding.

16. Internal wiring in the CCP shall be rated for 600 volts and 90°C with a minimum wire size No. 14 AWG for control circuits. Minimum wire size shall be No. 12 AWG for potential transformer circuits. Terminal blocks shall be 300 volt, 30A, barrier type screw terminals with 20% of the terminals on each terminal strip as spares. An engraved or painted wire number on a marking strip attached to the block shall identify each terminal. Interior power wiring for circuits larger than #4/0 shall be type DLO rated for use as those used for RHW and USE, UL Listed. Power and control wiring shall use separate terminal blocks from analog signal wiring. AC and DC wiring shall be run separately. Analog signal wiring shall be twisted shielded pairs as specified in Division 16.

17. Wiring shall be color-coded to delineate DC field wiring, AC field wiring, DC internal wiring, and AC internal wiring. Wiring shall be installed in plastic wiring ducts. Wiring outside the wiring ducts shall be bundled with plastic wrapping strips. The bundles shall be securely fastened to the steel of the panel using standard switchboard cleats located at suitable points between the terminal blocks and electrical devices. All wiring shall be in horizontal or vertical runs and groups of wires to and from common points shall be neatly harnessed and adequately supported. Flexible stranding shall be provided for swinging doors and panels.

18. Panel layout, and electrical control schematics and wiring diagrams shall be submitted in accordance with the submittal requirements specified herein. As built panel layout drawings, bills of material, and wiring diagrams of the completed panels shall be included in a drawing packet inside each control panel. Wiring diagrams shall show all control elements that originate or receive signals as part of the control system. Drawings shall be prepared specifically for this project. In addition, a detailed narrative functional description shall be submitted fully describing start-up, normal operation, and shutdown for automatic and manual control operations. All drawings shall be developed using AutoCAD 2017 or later version and one electronic digital copy of the dwg files, as well as pdf file copies of all drawings shall be provided with the O&M materials.

19. The Centrifuge Manufacturer shall furnish to the County, after start-up, two copies of the as-built drawings and control system programs on electronic media and two copies on print paper.

20. The CCP shall be provided with transient voltage surge suppression on the main power source and select PLC I/O signals. The transient voltage surge suppression devices shall match those devices used on other similar circuits at the FV WRF and be provided on the following locations:
    a. 120V main power feed into the CCP
    b. Digital I/O from sources that are outside the dewatering structure
    c. Analog I/O from sources that are outside the electrical room within the dewatering structure

21. The CCP shall provide for the following general control and monitoring functions:

    1. Automatic and manual start-up and shut-down of the system using the operator workstation (OWT) located on the control panel.

    2. Motor and instrument control parameters, status signals, alarms, and analog

values shall be displayed via the OWT.

3. Protective shutdown of the system through shutdown interlocks.

4. Process control for the sludge dewatering process and related subsystems, as described herein.

22. The CCP main control components shall consist of control relays and termination points for interconnection with ancillary equipment, the PLC equipment, and the panel mounted operator workstation. Door mounted components shall consist of the following devices:

    1. Operator Workstation (OWT)

    2. System Power ON/OFF push-to-test NEMA 12 indicator light, Allen Bradley Bulletin 800T/H or approved equal.

    3. Centrifuge Emergency STOP mushroom head red NEMA 12 pushbutton on the CCP wired in parallel to a field mounted emergency stop switch located at the centrifuge. Provide an emergency STOP mushroom head red NEMA 4X pushbutton mounted in a Type 316 stainless steel or aluminum NEMA 4X enclosure for installation by the electrical subcontractor adjacent to the centrifuge. Emergency stop pushbuttons shall be Allen Bradley Bulletin 800T/H or approved equal.

23. Unless specified, or indicated otherwise, all “RUN”, “START”, or “OPENED” indication on the OWT shall be red, all “OFF”, “STOP”, or “CLOSED” indication shall be green. Alarm indication shall be yellow.

24. Reserve space for installation of two video camera media converters for two cameras to be supplied under Section 13500 along with 120V power from within the panel. Provide connection of the media converters’ fiber optic outputs to the network switch within the panel for transmission to the County’s video surveillance equipment over the fiber optic network.

2.19 CENTRIFUGE CONTROL SEQUENCE AND CONTROL LOGIC

A. General

1. All programming and interlock logic for the centrifuge control PLC shall be the responsibility of the Centrifuge Manufacturer. Control program shall be the manufacturer’s standard customized for the required I/O. Refer to other details associated with the equipment control descriptions (VFD and motor control centers shall be as specified in Division 16).

2. The centrifuge and associated support system controls shall be controlled using the operator workstation (OWT) on the CCP. The OWT shall be used for display of all available system modes as described herein and shall display a graphical representation of the centrifuge, polymer preparation systems, centrifuge feed pumps, centrifuge feed pump grinders, dewatered sludge screw conveyor, centrate discharge chute washdown valve, solids discharge chute washdown valve, and centrifuge washdown valve complete with all alarms, controls, process

and electrical data. All control settings (timers, control set points, etc.) for the entire centrifuge dewatering system shall be adjustable from the OWT.

3. The “Emergency Stop” signals received from the CCP shall de-energize the master control relay and interrupt all run commands for immediate shutdown of the centrifuge equipment. The emergency stop(s) must be manually reset in order to restart the centrifuge.

4. The following centrifuge start, stop and clean-in-place sequences shall be considered as a minimum for each centrifuge.

B. Centrifuge Start-up Sequence

1. The centrifuge start-up sequence shall be initiated via the OWT after all the operator input and acknowledgement checks have been satisfied. The AUTO-START sequence shall not be initiated unless AUTO or REMOTE status is received from all equipment associated with the centrifuge.

2. On initiation of the AUTO-START sequence the centrifuge main (bowl) and secondary (scroll) drives shall be started. The main and secondary drives shall be ramped from 0% to 100% speed over a time interval established by the Centrifuge Manufacturer, but not to exceed 10 minutes.

3. After the main drive VFDs have indicated they are at 100% speed, the centrifuge PLC shall start the dewatered sludge screw conveyor. The centrifuge PLC shall send a RUN permissive command to the MCC to start the cake discharge conveyor (C-12-1).

4. Following receipt of RUN status of the dewatered sludge screw conveyor, the centrifuge PLC shall send a RUN permissive command to the selected polymer feeder to start the feeder and a RUN permissive command to the selected centrifuge feed pump VFD. Selection of the polymer feeder (number one or two) and the centrifuge feed pump and associated grinder (number one or two) shall be made through the plant SCADA system or the OWT. In the event that a run confirmation is not received from the both the selected polymer feeder and centrifuge feed pump and associated grinder after a time delay has elapsed, the centrifuge system shall shutdown. The centrifuge PLC shall open the dewatered cake chute gate (G-12-2) following the start of the centrifuge feed pump and associated grinder. An “open” dewatered cake chute gate is to be understood to direct discharge from the centrifuge to the centrate drain line and away from the discharge conveyor. The centrifuge washdown valve (V-11-9) shall also open with the dewatered cake chute gate for an adjustable time and then close. This start sequence shall be fully automated with an adjustable delay between each start of 0-60 seconds, with an initial setting of 20 seconds.

5. Centrifuge backdrive torque shall be monitored. The position of the dewatered cake chute gate (G-12-2) shall be based on backdrive torque. When the pre-set backdrive torque is reached, the centrifuge PLC shall close the dewatered cake chute gate (G-12-2). If the backdrive torque falls below the pre-set value the PLC shall re-open the dewatered cake chute gate (G-12-2).

C. Centrifuge Shutdown Sequence

1. The centrifuge automatic shutdown sequence shall be initiated via the OWT.

2. The polymer feeder and the centrifuge feed pump and associated grinder shall be stopped in that order with an adjustable delay between equipment stops between 0-60 seconds, with an initial setting of 20 seconds.

3. The centrifuge PLC shall open the dewatered cake chute gate (G-12-2). The centrifuge cake discharge conveyor and the dewatered cake chute gate shall be active for an adjustable time from 0-60 minutes, with an initial setting of 20 minutes. At the end of the time delay the dewatered cake chute gate shall close and the centrifuge cake discharge conveyor shall stop.

4. If the shutdown sequence is initiated from the OWT, then the operator shall be prompted via the OWT if the Clean-In-Place (CIP) routine should be initiated. If the CIP sequence is selected the centrifuge PLC shall initiate the CIP routine described herein. If the CIP mode has not been selected the main drive and secondary drive shall ramp down as described below.

5. The CCP shall allow for selection, via the OWT, for shutdown of the main and secondary drives by either a VFD ramp down mode, or a free spinning ramp down mode. The VFD “ramp-down” mode shall be by lowering the VFD output voltage/frequency to the main and secondary drive motors. Ramp down time shall be adjustable from 0-30 minutes, with an initial time to be recommended by the Centrifuge Manufacturer. Free spinning time shall be as determined by the Centrifuge Manufacturer.

D. Centrifuge Emergency Shutdown

1. When an emergency shutdown is activated, either at the E-Stop pushbutton, the equipment tag-line, or from the OWT, the centrifuge unit, polymer feeder, centrifuge feed pump and associated grinder, dewatered sludge conveyor, and the washwater system shall be shutdown immediately. A time delay shall be built in the control system such that the system start-up sequence shall not be possible until the time delay has elapsed. Emergency stop alarm shall be activated in the plant SCADA system.

E. Centrifuge Clean-In-Place (CIP) Sequence

1. If the CIP routine is selected, the centrifuge washdown valve shall be actuated to an open position and remain in the open position for a 0-60 minute adjustable time, with an initial setting of 20 minutes.

2. Following selection of the CIP mode, the CCP shall allow for selection, via the OWT or plant SCADA system, for shutdown of the main and secondary drives by either a VFD ramp down mode, or a free spinning ramp down mode as previously described.

3. If the Clean-in-Place sequence is initiated from the OWT directly (not part of the Shutdown Sequence); then the centrifuge washdown valve shall be actuated to

an open position and remain in the open position, the run permissive command for the selected centrifuge feed pump and associated grinder and the polymer feeder shall be removed by the centrifuge PLC. The operator shall be able to end this sequence by restoring the centrifuge to operation (close washdown valve and re-energize the centrifuge feed pump and associated grinder and polymer feeder) or complete the shutdown sequence in either VFD ramp down or free spinning ramp down mode.

F. Operating and Control Modes

1. Selection of the centrifuge operating mode between “MANUAL” and “AUTOMATIC” shall be provided via the OWT.

a. In the “MANUAL” operating mode, the differential speed shall be manually controlled with centrifuge torque varying within established limits. The setpoint input for this operating mode shall be 0-100% of the maximum allowable differential speed. The maximum allowable differential speed and maximum allowable torque inputs shall be password protected inputs to the control system.

b. In the “AUTOMATIC” operating mode, the centrifuge torque shall be set and the differential speed shall be adjusted automatically to maintain the desired torque setpoint. The setpoint input for this operating mode shall be 0-100% of the torque range. Upper limits on the maximum allowable torque shall be established and input as password protected inputs to the control system.

G. System Interlocks

1. In the event of a loss of RUN status of the selected polymer feeder, the centrifuge PLC shall immediately remove the run permissive command from the centrifuge feed pump and associated grinder and activate an alarm at the OWT and at the operator workstations in the plant SCADA system. The centrifuge PLC shall immediately reverse the direction of the cake discharge conveyor (C-12-1) and shall actuate the dewatered cake chute gate (G-12-2) to an open position when the alarm condition is activated. The centrifuge system shall remain in operation and be maintained for an adjustable time delay of 0-60 minutes, with an initial time setting of 20 minutes. The operator shall be prompted via the OWT to reset the alarm condition after manually checking the polymer feeder.

a. If the alarm condition is cleared and the process reset within the allowable time delay, then the centrifuge PLC shall start the selected polymer feeder and shall start the selected centrifuge feed pump and associated grinder. This restart sequence shall be fully automated with an adjustable delay between each start of 0-60 seconds, with an initial setting of 20 seconds. The centrifuge cake discharge conveyor shall re-start when the pre-set backdrive torque level is reached. When the centrifuge cake discharge conveyor restarts, the centrifuge PLC shall actuate the dewatered cake chute gate (G-12-2) to a closed position.

b. If the alarm condition is not reset before the time delay expires, the centrifuge system shall be shutdown in the normal sequence as described herein.

2. In the event of loss of RUN status of the centrifuge feed pump or its associated grinder, the centrifuge PLC shall immediately remove the run permissive command from the polymer feeder and activate an alarm at the OWT and at the operator workstations in the plant SCADA system. The centrifuge PLC shall immediately stop the centrifuge cake discharge conveyor and shall actuate the dewatered cake chute gate (G-12-2) to an open position when the alarm condition is activated. The centrifuge system shall remain in operation and be maintained for an adjustable time delay of 0-60 minutes, with an initial time setting of 20 minutes. The operator shall be prompted via the OWT to reset the alarm condition after manually checking the centrifuge feed pump and associated grinder.

   a. If the alarm condition is cleared and the process reset within the allowable time delay; then the centrifuge PLC shall start the selected polymer feeder and shall start the selected centrifuge feed pump and associated grinder. This restart sequence shall be fully automated with an adjustable delay between each start of 0-60 seconds, with an initial setting of 20 seconds. The centrifuge cake discharge conveyor shall re-start when the pre-set backdrive torque level is reached. When the centrifuge cake discharge conveyor is restarted, the centrifuge PLC shall actuate the dewatered cake chute gate (G-12-2) to a closed position.

   b. If the alarm condition is not reset before the time delay expires, the centrifuge system shall be shutdown in the normal sequence as described herein.

3. In the event of loss of RUN status of the centrifuge cake discharge conveyor, the centrifuge PLC shall remove the run permissive command from the centrifuge feed pump and associated grinder and the polymer feeder and activate an alarm at the OWT and at the operator workstations in the plant SCADA system. The centrifuge PLC shall also actuate the dewatered cake chute gate (G-12-2) to an open position. The centrifuge system shall remain in operation and be maintained for an adjustable time delay of 0-60 minutes, with an initial time setting of 30 minutes. The operator shall be prompted via the OWT to reset the alarm condition after manually checking the centrifuge cake discharge conveyor and associated electrical controls.

   a. If the alarm condition is cleared and the process reset within the allowable time delay; then the centrifuge PLC shall start the selected polymer feeder and start the selected centrifuge feed pump and associated grinder. This restart sequence shall be fully automated with an adjustable delay between each start of 0-60 seconds, with an initial setting of 20 seconds. The centrifuge cake discharge conveyor shall be re-started when the pre-set backdrive torque level is reached. When the centrifuge cake discharge conveyor is re-started, the centrifuge PLC shall actuate the dewatered cake chute gate (G-12-2) to a closed position.

b. If the alarm condition is not reset before the time delay expires, the centrifuge system shall be shutdown in the normal sequence as described herein.

4. In the event of a centrifuge malfunction (including, but not limited to, high vibration, bearing temperature, motor overtemperature, etc.), the centrifuge PLC shall immediately remove the RUN commands for the centrifuge feed pump and associated grinder, the polymer feeder and an alarm shall be activated at the OWT and at the operator workstations in the plant SCADA system. The centrifuge PLC shall stop the centrifuge cake discharge conveyor and shall direct the dewatered cake chute gate (G-12-2) to actuate to an open position. The centrifuge cake discharge conveyor and the dewatered cake chute gate shall be active for an adjustable time from 0-60 minutes, with an initial setting of 20 minutes. At the end of the time delay, the dewatered cake chute gate shall actuate to a closed position and the centrifuge cake discharge conveyor shall stop.

H. Dewatered Cake Conveyor Distribution Gates

1. The PLC shall alternate the position of the three discharge conveyor diverter gates (G-12-3, G-12-4, G-12-5, and G-12-6) based on the level signals in the truck bed from the level sensor associated with each gate as supplied with the conveyor.

2. When the conveyor first starts and after the dewatered cake chute gate is closed, the first diverter gate (G-12-3) shall open allowing dewatered cake to fall into the hauling truck bed.

3. Once the level sensor for that gate senses the level in the truck bed has reached a preset level, the first diverter gate (G-12-3) shall close and the second diverter gate (G-12-4) shall open.

4. Once the level sensor for that gate senses the level in the truck bed has reached a preset level, the second diverter gate (G-12-4) shall close and the third diverter gate (G-12-5) shall open

5. Once the level sensor for the third gate senses the level in the truck bed has reached a preset level, the third diverter gate (G-12-5) shall close and the fourth diverter gate (G-12-6) shall open

6. Once the level sensor for the fourth gate senses the level in the truck bed has reached a preset level, the fourth diverter gate (G-12-6) shall close and the cake will be diverted to the last truck chute on the conveyor which is always open.

7. Once the level sensor over the last truck chute senses the level in the truck bed has reached a preset level, the first diverter gate (G-12-3) shall open so the cake will be re-diverted back to that end of the truck and the cycle is repeated in level increments as set by the operators to evenly distribute the cake load throughout the truck bed and the truck is completely full ready to be changed out to an empty truck bed. Level setpoints shall be created either as separate setpoints for

each new level cycle or shall automatically increase by an amount set by the operators.

8. When a truck has reach a full state, the centrifuge system shall shutdown and operators alerted to a full truck condition. Operators may reset the full truck condition at any time to restart the gate cycle to first diverter gate.

I. Washwater Booster Pump: Controls shall start the booster pump whenever washwater or cooling water is required. A low pressure switch on the booster pump discharge line shall provide an alarm and begin a shutdown sequence.

2.20 OPERATOR INTERFACE UNIT FOR THE CENTRIFUGE CONTROL PANEL

A. The centrifuge operator workstation (OWT) shall have screens that represent the process and associated system parameters. The minimum information to be displayed shall include, but not be limited to:

1. Overview Screen

2. Centrifuge Start-Up Sequence Screen

3. Detail Screens

a. Centrifuge

b. Centrifuge Feed Pumps and associated Grinders

c. Polymer Feeder

d. Dewatered Sludge Screw Conveyor and diverter gates

e. Electrical Parameters

f. Communication Status and Statistics

4. Front Panel Display of all alarms

5. Alarm log

6. Password protected display of run time and maintenance statistics

7. Password protected display for alarms and shutdown time delays that are operator adjustable.

8. Firmware display data

9. Clean In Place Prompting

B. Overview Screen:

1. The overview screen shall show all of the following components in process

schematic form:

a. Centrifuge System - Main Drive, Secondary Drive, Scroll, and Bowl

b. Centrifuge Feed Pumps and associated grinders

c. Polymer Feeders

d. Dewatered Sludge Screw Conveyor and diverter gates

2. The overview screen shall indicate whether equipment is running, off, or malfunctioned. In addition, links shall be provided to the maintenance screen to indicate when equipment is out of service for maintenance or operational reasons. When a given piece of equipment is to be placed out of service for maintenance, the operator shall be able to go to the maintenance screen and check off a box that indicates out of service. Once this box is checked, the equipment shall be prevented from running.

3. The operator shall have the ability to go to the detail screen for all of the items shown on the overview screen by touching the component of interest.

C. Centrifuge Start-up Screen:

1. This screen shows the user which of the following options have been manually selected.

a. Centrifuge Feed Pump - show AUTO status selected from the VFD

b. Centrifuge Feed Pump Grinder – show AUTO status from the MCC

c. Polymer Feeder - show AUTO status selected from the feeder

d. Dewatered Sludge Screw Conveyor - show AUTO status from the MCC.

e. dewatered cake chute gate (G-12-2) – show REMOTE status from the gate actuator.

f. centrifuge washdown valve (V-11-9)) – show REMOTE status from the valve actuator.

g. discharge conveyor diverter gates (G-12-3, G-12-4, and G-12-5) – show REMOTE status from the gate actuators.

2. The operator shall be required to check a box on the screen indicating that all manual valves are configured for the selected set-up for the centrifuge feed pump and polymer feeder.

3. The operator shall be guided through the centrifuge set-up process by a series of “wizards” which shall instruct the user as to which items must be configured before the system shall be started. The operator shall not be allowed to proceed to the next step in the set-up process until the process has been properly

configured. The start-up process shall not progress unless all process and control conditions are configured to allow the CCP to control all of the equipment as previously described.

4. The operator shall be required to input a desired centrifuge feed pump and polymer feeder setpoint prior to initiating the automatic start sequence. The desired centrifuge feed pump and polymer feeder setpoint shall be used during initial start-up sequence. Adjustment following start-up shall be from the centrifuge feed pump or polymer feeder screens on the OWT.

D. Centrifuge Detail Screen

1. The centrifuge screen shall show the following components:

   a. Centrifuge Operating Mode (MANUAL/AUTOMATIC)

   b. centrifuge wash water (indicate open/closed)

   c. Discharge chute gate (indicate open/closed)

   d. Main Drive Status (Running/Off/Malfunction)

   e. Main Drive Speed

   f. Secondary Drive Status (Running/Off Malfunction)

   g. Secondary Drive Speed Process Variable

   h. Secondary Drive Speed Setpoint (calculated from centrifuge PLC)

   i. Differential Speed Setpoint (entered for “MANUAL” operating mode)

   j. Secondary Drive Torque Process Variable

   k. Secondary Drive Torque Setpoint (entered for “AUTO” operating mode)

2. The centrifuge screen shall provide for the input of the differential speed setpoint when the operating mode is in “MANUAL”, and for the secondary drive torque setpoint when the operating mode is in “AUTO”.

E. Centrifuge Feed Pump Detail Screen

1. The centrifuge feed pump detail screen shall show whether the pump is Running/Off/Malfunctioned (alarms associated with the centrifuge feed pumps shall also be indicated on this detail screen). The PLC shall calculate the runtime of each pump and grinder (hours and 10nths of hours).

2. The centrifuge feed pump detail screen shall show whether the pump’s associated grinder is Running/Off/Malfunctioned (alarms associated with the grinder shall also be indicated on this detail screen).

3. The centrifuge feed pump detail screen shall indicate the speed of the pump in percentage. The screen shall indicate the centrifuge feed flow rate (in gallons per minute) from the magnetic flow meter (FE/FIT-100) associated with the centrifuge feed piping.

4. The centrifuge feed pump detail screen shall allow the operator to START/STOP a selected centrifuge feed pump (which will also start/stop the associated grinder).

5. The centrifuge feed pump detail screen shall provide for the selection of “SPEED CONTROL” mode or “FLOW CONTROL” mode. The centrifuge feed pump screen shall provide for the input of the pump speed setpoint when the operating mode is in “SPEED CONTROL” mode and for the flow rate setpoint when the operating mode is in “FLOW CONTROL” mode. Pump speed or flow rate setpoint shall be transmitted to the centrifuge feed pump VFD via the dewatering building PLC.

F. Polymer feeder Detail Screen

1. The polymer feeder detail screen shall show whether the polymer feeder is Running/Off/Malfunctioned (alarms associated with the polymer feeders shall be indicated on this detail screen). The screen shall also show the volume of polymer as measured by the tote weigh scales provided with the polymer feed system and the polymer feed rate (gph) as measured by the flow meters provided with the feeders.

2. The Centrifuge Manufacturer shall coordinate with the polymer feeder manufacturer to obtain a curve that correlates percentage of polymer feeder speed to gallons per minute flow rate.

3. The screen shall indicate the speed of the polymer feeder in percentage. The screen shall convert the speed percentage to an equivalent gallon per minute value based on the polymer feeder curve and indicate the calculated polymer solution flow rate.

4. The polymer feeder detail screen shall allow the operator to START/STOP the selected polymer feeder.

5. The polymer feeder screen shall provide for the selection of “SPEED CONTROL” mode or “FLOW CONTROL” mode. The polymer feeder screen shall provide for the input of the polymer feeder speed setpoint when the operating mode is in “SPEED CONTROL” and for the polymer feed ratio setpoint (relative to the sludge flow rate) when the operating mode is in “FLOW CONTROL”. The screen shall calculate the polymer feed rate in gallons per minute based on the polymer feed ratio setpoint and convert the polymer feed rate to the corresponding polymer feeder speed based on the manufacturer’s curve. The polymer feeder speed shall be sent directly to the selected polymer feeder VFD.

G. Dewatered Sludge Screw Conveyor Detail Screen

1. The dewatered sludge screw conveyor detail screen shall indicate the status of

the cake distribution conveyor.

2. The cake distribution conveyor shall have the following data displayed:

   a. Conveyor Status – Auto, Running, and Fault

   b. Levels in the truck bed

   c. Discharge conveyor diverter gates (indicate open/closed/auto/fault)

H. Electrical Parameters Detail Screen

1. The electrical parameters screen shall include all of the following for the main drive and the secondary drive:

   a. Current In Amperes (use circular dial display to simulate an analog meter)

   b. Voltage In Volts (use circular dial display to simulate an analog meter)

   c. Power in Watts (use circular dial display to simulate an analog meter)

   d. Any drive failure alarms shall be shown on this screen

2. Provide a trend of the current and voltage with respect to time.

3. Provide a trend of power use with respect to time.

4. Provide prompting for the operator to select main and secondary drive shutdown in either a free spinning or ramp down mode.

I. Communications Parameters Screen

1. Screen shall show status of the Ethernet network switch

2. The screen shall display the number of messages sent.

3. The screen shall display the number of “no acknowledge” messages accumulated.

4. The screen shall display the number of time-outs or watchdogs.

5. The screen shall provide a password protection input for any operator adjustable password protected parameters.

J. Front Panel of Display of Alarm

1. Set-up a matrix of alarms (based on layout input from the County) to mimic an annunciation panel.

2. The panel shall use the following alarm sequence:

a. When an alarm is detected the screen box allocated for that condition shall illuminate.

b. The operator shall be capable of acknowledging the alarm.

c. When the alarm is acknowledged, the alarm shall stay steadily illuminated.

d. When the alarm condition is cleared the unit alarm box on the OWT shall be deactivated.

K. Alarm Log

1. Provide a text display of all alarm conditions. The display shall be stamped with the date and time at which the alarm condition occurred and when it was cleared.

L. Operations and Run Time Statistics

1. This screen shall include separate accumulators for total run time (non-resettable) on the following pieces of equipment:

a. Main Drive

b. Secondary Drive

c. Bowl

2. This screen shall include accumulators for run time since last maintenance (resettable) on the following pieces of equipment:

a. Main Drive

b. Secondary Drive

c. Bowl

3. When the scheduled maintenance period for each piece of equipment is approached, the unit shall send and display a warning indicating that maintenance is needed.

M. Pass Word Protected Time Delays and Process Control Settings

1. Provide a separate screen for the setting of time delays associated with all software triggered alarms. The screen shall be in a tabular format listing the English language of the alarm condition and its corresponding time delay. Next to the adjustable delay, the manufacturer shall list the default setting as guidance.

N. Firmware Data

1. Display the following information:

a. License number (for each item where a software/firmware license is required)

b. The version of the software/firmware being used. Screen shall allow for password protected change to this data to indicate that the data has been changed.

c. Provide a place on the screen to allow for the operator to indicate the date when new firmware was entered.

O. Clean in Place Display

1. The operator shall be prompted during the shutdown sequence described herein to run the clean in place sequence.

2.22 PANEL CONTROL AND WIRING COMPONENTS

1. Programmable Controller (PLC): The PLC shall be Allen-Bradley CompactLogix Catalog No. 1769-L series controlloers using Rockwell Automation RSLogix 5000 Professional Edition software to match PLC components and software versions supplied under Division 17. Provide I/O modules Catalog No. 1769-IQ16 24Vdc discrete input modules, Catalog No. 1769-OB16 24Vdc discrete output modules, Catalog No. 1769-IF8 4-20mA analog input modules (with Allen Bradley or Phoenix Contact Hart enabled isolators), and Catalog No. 1769-OF8C 4-20mA analog output modules. Power supplies shall be Allen Bradley 1769-PA series. PLC hardware and software shall be provided to allow operators to make changes to setpoints and control settings within the PLC over the plant SCADA network. Software ladder programming shall be set up to allow modifications to the programming either through direct laptop connection at the PLC or over the telemetry link. Provide input/output modules in sufficient quantities specified herein and as required to meet functional requirements of the Specification. PLC hardware and power supplies shall be provided with all necessary cabling, mounting hardware, racks and connectors for a fully functional system. I/O teriminal strips shall be removable without disturbing field wiring. Provide a minimum of 10% spare slot capacity in the card rack for future expansion and 15% spare I/O capacity for each type of input (rounded up to the next whole number of required points or channels). Provide 25% spare memory on the PLC CPU after the PLC has been programmed for full operation. Minimum I/O shall be as follows:

    1. 120V power to oil lube air supply solenoid (DO)
    2. 120V power to oil lube oil supply solenoid (DO)
    3. Low oil lube system air pressure (DI)
    4. Low oil lube oil pressure (AI)
    5. Low oil lube oil level (AI)
    6. Air compressor running (DI)
    7. Air compressor system fault (DI)
    8. Air compressor system in Auto (DI)

9. Proportional valve position control (AO)
10. Backdrive oil temperature (AI)
11. Backdrive oil level (AI)
12. Backdrive hydraulic oil pressure (AI)
13. Main drive speed proximity switch (AI)
14. Backdrive speed proximity switch (AI)
15. Main drive optical speed sensor (AI)
16. Back drive optical speed sensor (AI)
17. Centrifuge vibration sensor (AI)
18. Main bearing 1 temperature sensor (AI)
19. Main bearing 2 temperature sensor (AI)
20. Main drive motor high temperature (DI)
21. Main drive HOR switch In REMOTE (DI)
22. Start main drive motor (DO)
23. Main drive Running (DI)
24. Main drive VFD Fault (DI)
25. Main drive VFD Enclosure High Temperature (DI)
26. Main drive High Motor Current (DI)
27. Main drive speed feedback (AI)
28. Main drive Motor Current (AI)
29. Main drive speed reference command (AO)
30. Backdrive motor high temperature (DI)
31. Backdrive HOR switch In Remote (DI)
32. Backdrive start command (DO)
33. Backdrive Motor Running (DI)
34. Backdrive starter fault (DI)
35. Feed pump grinders 1 and 2 start commands (DO)
36. Feed pump grinders 1 and 2 running signals (DI)
37. Feed pump grinders 1 and 2 starter fault signals (DI)
38. Feed pump grinders 1 and 2 HOR In Remote signals (DI)
39. Sludge feed pumps 1 and 2 start commands (DO)
40. Sludge feed pumps 1 and 2 running signals (DI)
41. Sludge feed pumps 1 and 2 VFD fault signals (DI)
42. Sludge feed pumps 1 and 2 HOR In Local signals (DI) (not in remote)
43. Sludge feed pumps 1 and 2 low pressure signals (DI)

44. Sludge feed pumps 1 and 2 high pressure signals (DI)
45. Sludge feed pumps 1 and 2 motor high temperature signals (DI)
46. Sludge feed pumps 1 and 2 dry pump signals (DI)
47. Sludge feed pumps 1 and 2 low seal water flow signals (DI)
48. Sludge feed pumps 1 and 2 high VFD temperature signals (DI)
49. Sludge feed pumps 1 and 2 speed feedback signals (AI)
50. Sludge feed pumps 1 and 2 speed reference commands (AO)
51. Sludge feed pumps 1 and 2 motor current (AI)
52. Sludge feed pumps 1 and 2 remote reset (DO)
53. Polymer feeders 1 and 2 start commands (DO)
54. Polymer feeders 1 and 2 running signals (DI)
55. Polymer feeders 1 and 2 fault signals (DI)
56. Polymer feeders 1 and 2 In Remote signals (DI)
57. Polymer feeders 1 and 2 speed feedback signals (AI)
58. Polymer feeders 1 and 2 speed reference commands (AO)
59. Polymer tote weigh scales 1 and 2 weight (AI)
60. Open commands for all four truck loading slide gates (DO)
61. Close commands for all four truck loading slide gates (DO)
62. Opened status for all four truck loading slide gates (DI)
63. Closed status for all four truck loading slide gates (DI)
64. In Remote status from OCR for all four truck loading slide gates (DI)
65. Fault signal from all four truck loading slide gates (DI)
66. Open and Close commands for centrifuge discharge diverter slide gate (DO)
67. Opened status for centrifuge discharge diverter slide gate (DI)
68. Closed status for centrifuge discharge diverter slide gate (DI)
69. In Remote status from OCR for centrifuge discharge diverter slide gate (DI)
70. Fault signal from centrifuge discharge diverter slide gate (DI)
71. Sludge feed flow (AI)
72. Centrifuge emergency stop (DI)
73. Truck loading conveyor truck bed level sensors (total of 5) (AI)
74. 24Vdc power to cooling water solenoid (DO)
75. 24Vdc power to washwater solenoid (DO)
76. Washwater supply low pressure (DI)
77. Washwater booster pump start command (DO)
78. Washwater booster pump running signal (DI)

79. Washwater booster pump starter fault signal (DI)
80. Washwater booster pump HOR In Remote signal (DI)
81. Truck loading conveyor start command (DO)
82. Truck loading conveyor running signal (DI)
83. Truck loading conveyor starter fault signal (DI)
84. Truck loading conveyor HOR In Remote signal (DI)
85. Truck loading conveyor no speed signal (DI)
86. High temperature alarm from building A/C system controls

Wiring and conduit between the CCP and external devices for the I/O shall be supplied and furnished under Division 16. Contractor shall coordinate between the centrifuge manufacturer and the Division 16 electrical subcontractor to provide the appropriate number, size, and type of wire required for the needed wiring interface

2. Operator Interface: Operator Workstation (OWT) shall be an Allen Bradley Panelview Plus 15-inch, TFT color display and shall be programmed to allow full and complete control and monitoring of the centrifuge operation. Operator input is to be available through touch screen interface. Operator Interface shall be 24Vdc powered, mounted on the panel front door.

3. Fiber Optic Interface: The panel PLC shall communicate with the plant PLC network directly over a fiber optic link. PLC Fiber Optic module, fiber cable, and fiber conduit shall match existing fiber optic network equipment using Sixnet Media Converters. Fiber optic cable connections shall match existing cable connection type. The PLC and OWT shall communicate with the plant PLC network through a managed network switch, Ntron or approved equal, with integral fiber optic converter. Network switch shall use County assigned IP addresses and standard plant network communications protocol. Network switch shall include a port for communications to the plant network for the new hypochlorite PLC panel provide under Division 17.

4. Panel Ventilation: The panel shall be fitted with a front-mounted ventilation fan(s) and louver(s) to adequately dissipate heat into the air-conditioned electrical room. Units shall operate on 120V ac power and include replaceable activated carbon filters on the air intakes. Thermostat shall be mounted inside the panel.

5. As-built Drawings: A laminated “As Built” copy of the panel wiring diagrams shall be provided and placed in the panel print pocket for all panels that include PLCs. All panel drawings shall be developed using AutoCad®. The drawings shall have a complete Bill of Materials, panel exterior and interior layouts, and show all electrical wiring. As-built drawings shall be submitted with the O&M materials on electronic media in both AutoCad® (.dwg) and Adobe Acrobat® (.pdf).

6. Terminals: Terminal blocks shall be as follows:

   a. Terminal blocks shall be assembled on non-current carrying galvanized steel DIN mounting rails securely bolted to the cabinet subpanel. Terminals shall

be of the screw down pressure plate type as manufactured by Allen Bradley or Phoenix Contact.

b. Power terminal blocks for both 120 VAC and 24 VDC power shall be single tier with a minimum rating of 600 volts, 30 amps.

c. Discrete signal terminal blocks shall be 2-tier with a minimum rating of 600 volts, 20 amps. One terminal block shall be used for each signal. The positive wire shall be installed on the top or left-most terminal.

d. Analog signal terminal blocks shall be 3-tier with a minimum rating of 600 volts, 20 amps. One terminal block shall be used for each signal. The positive wire shall be installed on the top or left-most terminal and the shield/drain wire shall be installed on the bottom or right-most terminal.

e. Only one wire shall be terminated under a single wire clamp or screw.

f. Terminal blocks for field wire connections shall be added as needed in 10-pole increments. Terminal blocks shall be mounted with a minimum of 2" from both enclosure sides and from the bottom of the enclosure for easy access to terminal screws.

g. Terminals shall be marked with a permanent, continuous marking strip. One side of each terminal shall be reserved exclusively for field incoming conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal.

h. Separate terminal strips shall be provided for each type of power and signal used within each cabinet. Where applicable, terminal strips for different voltages of discrete signal wiring shall also be separated. Terminal strips shall be labeled as to voltage and function.

7. Wiring: All wiring shall be color-coded using tinned copper MTW #14 AWG minimum for power and control wiring and #16 twisted pair for analog signal wiring. Wiring and cables shall be numbered at each end. Wire numbers shall be printed on non-removable heat-shrink tags. Wires shall be color coded as follows:

Equipment Ground - GREEN

120 VAC Power - BLACK
120 VAC Power Neutral - WHITE

120 VAC Control (Internally Powered) - RED
120 VAC Control (Externally Powered) - YELLOW

24 VAC Control - ORANGE

DC Power (+) - BLUE
DC Power (-) - GRAY

Analog Signal – BLACK/WHITE

8. Component Labels: All interior panel components shall be individually labeled on the back plate with a custom engraved plastic tag with adhesive back. The tags shall be white with black letters and match the nomenclature indicated on the as-built wiring diagrams.

9. Mounting Hardware: All mounting hardware such as screws or bolts used in the manufacturing of the control panel shall be Type 316 stainless steel. All holes in the back plate and dead front shall be drilled and tapped. No self-tapping screws, adhesive tapes, or Velcro will be accepted for the mounting of any hardware.

10. Interposing relays shall be provided on all discrete outputs on the PLC and shall be DIN rail mounting type, DPDT, minimum 10 amp, 120 VAC contact rating. Relay coils shall be 120 VAC or 24 VDC as required. Relays shall have a flag indicator to show relay status, a pushbutton to allow manual operation of the relay, and an internal pilot light to indicate power to the coil. Relays shall be as manufactured by Phoenix Contact or Allen Bradley.

11. Timing Relays shall be provided for any direct wired equipment protection circuits to prevent nuisance tripping. Timing relays shall be the general purpose DIN rail mounting type, as manufactured by Phoenix Contact. Timing relays shall be electronic type with 120 VAC coils unless otherwise specified or indicated on the Drawings. Timers shall be provided with a minimum of two SPDT timed output contacts and instantaneous contacts where required. Contact ratings shall be the same as for interposing relays as specified above.

12. Corrosion Protection: Panel interior components shall be treated with a corrosion inhibiting spray on all exposed metallic surfaces, particularly terminations, contacts, and wire ends. After installation, furnish corrosion inhibiting capsules that emit molecular level coating on metallic surfaces throughout the panel that provide specific corrosion barrier toward hydrogen sulfide and/or subsequent formation of sulfuric acid when combined with ambient moisture.

13. Panel Seal-Offs: Furnish and install panel seal-offs on all conduits leading to equipment installed in ambient outside air or process areas to prohibit exposure to corrosive gasses. Panel seal-offs shall be mounted near the equipment and shall be provided with terminations on either side of the epoxy-based seal-off material to allow for replacement of cable without breaking the seal. All conduits entering a panel or enclosure shall be sealed at the conduit entry point with a removable, expandable conduit seal material to further prohibit outside air or process gasses from entering the panel.

2.23 WASHWATER BOOSTER PUMP

A. Plant water (non-potable water source for centrifuge washwater and cooling water) is typically in a range of 40 to 55 psi at ground level. The centrifuge is elevated more than 25 feet above grade which will reduce this pressure range. The centrifuge manufacturer shall provide an in-line grade level booster pump to boost the supply water pressure to be within the required operating range of the centrifuge. The pump shall be a centrifugal horizontal close-coupled end suction pump, Goulds Series A-C 2000, or equivalent as manufactured by Aurora Pump, or approved equal.

B. The casing shall be of the end suction design with tangential discharge outlet. Suction and discharge connections shall be flat-faced flange connections. Flange connections shall be ANSI 125 lbs. rated. The casing bore shall be large enough to allow "back pullout" of the impeller without disturbing the casing or suction and discharge piping. Pump construction shall be as follows:

1.	Casing:	Cast Iron, ASTM A48
2.	Wear Rings:	Bronze Alloy, radial type
3.	Stuffing Box:	Cast Iron, integrally cast
4.	Impeller:	Bronze Alloy, enclosed type, vacuum cast, dynamically balanced, keyed to shaft
5.	Shaft Sleeve:	Bronze Alloy
6.	Impeller Nut and Washer:	Plated Steel
7.	Gland:	Zinc Alloy
8.	Mechanical Seal:	AISI Type 316 Stainless Steel, inside balanced elastomeric bellows type
9.	Seal Case:	Teflon
10.	Shaft:	Steel, AISI C1045
11.	Close-Coupled Adaptor:	Cast Iron
12.	Motor:	Minimum 5 hp, shall not exceed the rated motor horsepower at any point on pump curve, TEFC, 460V, 3 phase, 60 Hz, 1750 rpm
13.	Duty Point:	Minimum 150 gpm at 70 feet TDH, actual sizing to be verified by centrifuge manufacturer for this application and conditions
14.	Spare Parts:	One complete spare pump and motor
15.	Model:	Goulds Model 600, 3x2x9 or equivalent
16.	Suction Size:	3 inch
17.	Discharge Size:	2 inch
18.	Efficiency:	63%

C. Contractor shall provide a concrete pad per Detail 8, Sheet S-9 sized to secure the pump using stainless steel concrete anchors. Location shall be as shown on the Drawings. Pad dimensions shall be 6” beyond the outer dimensions of the pump size (roughly 2’ x 3’) and 8” thick.

D. Contractor shall provide SCH 80 PVC suction and discharge piping with the following fittings and valves:

1. True-union PVC isolation ball valves on the suction and discharge sides.
2. PVC flanged connections to the pump with stainless steel nuts, washers, and bolts

3. PVC to DIP reducer fittings to transition suction and discharge piping to 4" DIP for connection to the plant supply line and continuation up to the centrifuge.

E. Centrifuge manufacturer shall provide a low pressure switch on the discharge side of the pump, Ashcroft Type 400B or approved equal, complete with all Type 316 stainless steel diaphragm seal and Type 316 stainless steel isolation ball valve with 1/2" process connection.

F. Centrifuge manufacturer shall provide a Hand/Off/Remote NEMA 4X selector switch mounted in a Type 316 stainless steel or aluminum NEMA 4X enclosure for installation by the electrical subcontractor adjacent to the booster pump. Selector switch shall be Allen Bradley Bulletin 800T/H or approved equal

2.24 SOLENDOID VALVES

A. All solenoid valves shall be Type 316 stainless steel, NEMA 4X rated. Solenoids for the lube system air and oil solenoids, the cooling water solenoid, and the bowl flush solenoid shall operated on a 24Vdc signal from the CCP.

PART 3 – EXECUTION

3.01 MANUFACTURER FIELD SERVICES

A. The Contractor shall coordinate with the Centrifuge Manufacturer all details, locations, clearances, and other conditions so that the equipment shall function as part of a complete system.

B. The Contractor shall provide the services of a qualified manufacturer's technical representative who shall adequately supervise the installation and testing of all equipment furnished under this Contract and instruct the County's operating personnel in its maintenance and operation as outlined in Section 11000, Equipment General Provisions. As a minimum, the manufacturer's technical service representative shall provide the following field services:

Service Description	Number of Trips	Service Duration
Installation	1	2 days
Field Test and Start-up	1	3 days
Performance Testing	As Required	As Required
County O&M Training	1	2 days

C. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor. The manufacturer's representative shall sign in and out of the office of the Engineer's resident Project Representative in each day he is at the project.

3.02 MANUFACTURER PROVIDED TRAINING

A. The Centrifuge Manufacturer shall provide on-site training for the operation and maintenance of all centrifuge components and the associated auxiliary equipment specified herein. Training shall be provided by the Centrifuge Manufacturer's personnel who are experienced in the operation and maintenance of high solids centrifuge equipment.

B. All training submittals shall be approved by the Engineer prior to systems start-up. All training requirements shall be satisfied before acceptance by the Engineer of the system and prior to final acceptance by the County.

C. The Centrifuge Manufacturer shall provide the following submittals for training:

1. Detailed listing of training to be provided

2. Detailed listing of course content and learning objectives

3. Qualifications and experience of individuals providing training

D. A minimum of 21 days prior to the beginning of each scheduled training course, documentation for use during the training shall be submitted for the County's personnel to review prior to training and use during training. Ten (10) copies of the training materials shall be provided. The training documentation shall be specific to the particular course and shall include the following:

1. Detailed listing of all subjects to be covered.

2. Learning objectives for the training session.

3. Detailed documentation and/or lesson plans covering all subjects to be covered during the course instruction. Information shall be in a "how to" format for use in operator training sessions. Provide sufficient background documentation and Manufacturer's literature to provide a thorough and clear understanding of the materials to be covered.

E. The Centrifuge Manufacturer shall bear all costs associated with training, except for labor costs associated with County's personnel.

F. Training courses shall be designed to provide detailed training that is commensurate with the skills and experience levels of County's personnel.

G. Training classes shall include lecture as well as "hands on" experience for each of the attending personnel. The Centrifuge Manufacturer shall provide sufficient equipment for this to be accomplished.

H. Operations and Maintenance Training

1. Fundamental O&M Topics – The Centrifuge Manufacturer shall provide an overview course segment designed to present a general overview of centrifuge dewatering process theory. The "Fundamentals" course shall also include

descriptions and review of the various components and process ratings for each piece of equipment associated with the installed system.

2. Site Specific O&M Topics - The Centrifuge Manufacturer shall provide site specific topics course segment which shall include as a minimum the following topics:

   a. General Equipment Operation

   b. Equipment Set-up Procedure

   c. Equipment Start-up Procedure

   d. Equipment Shut-down Procedure

   e. Equipment Routine and Preventive Maintenance Checks and Services

   f. Default Settings for Process Equipment

   g. Process Performance Optimization and Troubleshooting

   h. Equipment Alarms and Mechanical Troubleshooting

I. Control Systems Training

1. Control system training shall be provided as a separate training course from the O&M training course segments described above. Control systems training course segments shall be developed for separate target audiences as follows: (1) centrifuge equipment operators; and (2) control systems maintenance technicians.

2. The centrifuge operator training shall focus on the correct configuration of the centrifuge for set-up, start-up and shutdown via the Operator Workstation (OWT).

3. The control systems maintenance technician training shall include the troubleshooting of the OWT, the I/O modules, PLC CPU, and OWT. The troubleshooting class shall also include training associated with communications between the CENTRIFUGE PLC and the other plant SCADA systems.

4. The control systems maintenance technician training PLC training shall include a reading of the PLC documentation from the fully commented PLC code, how to edit code, how to run code off-line (for simulation), how to download code, and how to check communications.

5. The control systems maintenance technician training instrument training shall include preventative maintenance checks and services for all of the vibration monitoring, RTD, and other centrifuge specific instrumentation.

3.03 MANUFACTURER SHOP TESTS

A. The shop tests of the complete centrifuge assemblies shall be performed at the Centrifuge Manufacturer’s shop. These tests shall demonstrate the absence of

mechanical or electrical defects (e.g., dye penetrate test of bowl and scroll assemblies) and that the centrifuges operate within the specified limits of noise and vibrations.

B. All centrifuge control panels shall be shop tested to verify their full compliance with the functional descriptions specified herein.

C. Results of the manufacturer's shop testing activities shall be submitted to the Engineer prior to shipment of the affected components to the project site.

3.04 ON-SITE FIELD TESTS

A. Field tests shall be performed in accordance with Section 01600 and the on-site test procedure approved by the Engineer.

B. The field tests shall demonstrate, at a minimum, the following:

1. The centrifuge equipment was properly installed and in proper alignment.

2. The centrifuge is mechanically sound and ready for operation.

3. The centrifuge and its ancillary equipment operate without overheating, overloading of any parts or systems, and operate within the specified limits of vibrations, noise, temperatures, pressures, torque, etc.

4. The centrifuge can operate within the specified limits of solids feed and polymer feed flow rates producing cake of the specified consistency.
5. The centrifuge control panels (CCP and CCP) and PLC effectively control the components of the dewatering system as specified.

C. The field tests shall be run, under the Centrifuge Manufacturer's supervision, by qualified technical representatives of the Centrifuge Manufacturer.

D. It shall be the Contractor's responsibility to make sure that qualified technical representatives of the ancillary equipment manufacturers are promptly available as required during the field-testing to facilitate testing and start-up of the high solids centrifuge dewatering system.

3.05 PERFORMANCE TESTS

A. Performance tests shall be conducted to demonstrate the full compliance of the equipment supplied with the Performance Requirements and Guarantees of this Section.

B. The Centrifuge Manufacturer shall submit a Performance Test Plan to the Engineer for review at least 30-days prior to commencing performance tests.

C. Performance testing shall consist of four (4) test runs. The results of one (1) test run may be discarded in making demonstration of acceptable performance. Each of the remaining three (3) runs must satisfy all of the performance guarantee criteria for the performance test to be successful. If the test is failed, the damages shall be assessed on the basis of the worst of the three (3) remaining test runs.

D. Each test run shall consist of at least six (6) consecutive hours of operation at near uniform feed conditions with regard to flow or solids loading rate. Operating data and field samples shall be collected at approximately hourly intervals during the performance test such that at least six data points are generated or recorded during each test run. The average performance for the test run shall be the arithmetic average of the individual data points for the key operating and performance parameters. The averaged data within the test run shall constitute the basis for assessing performance for the test run.

E. The performance test shall be conducted on the centrifuge as soon as practicable after the centrifuge and ancillary equipment required make a functional system becomes operable. The performance testing shall be conducted at a date acceptable to the County.

F. In the event that the equipment is not meeting the guaranteed performance standards, the Centrifuge Manufacturer shall have the equipment altered as necessary to meet the guaranteed performance standards. All costs associated with the modifications shall be borne by the Centrifuge Manufacturer. Upon modifying the test centrifuge assembly, the Centrifuge Manufacturer must repeat the performance test series. The most recently generated results will govern.

G. A maximum of two additional performance tests following the initial performance test (e.g., maximum of three (3) performance test cycles) shall be permitted. If the equipment still does not meet the guaranteed standards, the Centrifuge Manufacturer will be assessed damages as specified elsewhere in this Section.

H. Analytical tests required to conduct the performance test shall be conducted by a certified (i.e., meets state standards for submittal of analytical results for the applicable tests for regulatory reporting purposes) laboratory agreed upon by the Centrifuge Manufacturer and the County. The cost of laboratory testing shall be borne by the County for the first performance test. Laboratory costs for subsequent performance tests, if required, shall be borne by the Centrifuge Manufacturer.

I. Test records shall be maintained to insure that the specified results are met through the duration of the test. Copies of the original field data collection sheets shall be submitted with the performance test report. The original field data collection sheets shall be signed by representatives of the Centrifuge Manufacturer, Contractor, and County at the completion of each performance test run.

J. The Centrifuge Manufacturer is responsible for all special tools, meters and test instruments necessary to demonstrate these requirements.

K. The Engineer may request additional certified test data or call for on-site test to confirm the accuracy of all instruments used in testing.

L. The Centrifuge Manufacturer shall perform jar tests on the centrifuge feed sludge and select polymer for use with the dewatering equipment. The Contractor shall purchase the recommended polymer for use during performance testing and the 10 day start-up period required by Section 01660. At the end of the start-up period, the Contractor shall supply sufficient bulk neat polymer to fill the bulk neat polymer tanks for each plant.

3.06 SPECIAL TOOLS, SUPPLIES AND SPARE PARTS

A. The Centrifuge Manufacturer shall furnish special tools required for the maintenance and repair of the high solids centrifuge equipment. One (1) set of all special wrenches and special tools required to disassemble, service, repair and adjust the supplied equipment shall be provided. The Centrifuge Manufacturer shall supply all lifting devices necessary to ensure that the disassembled centrifuge items can be lifted with the Overhead Bridge Crane. As a minimum the set of special tools shall include, but not be limited to:

1. One (1) – Base Lifting Device
2. One (1) – Bowl Truck
3. One (1) – Bowl Lifting Device
4. One (1) – Conveyor Lifting Device
5. One (1) – Set Conveyor Extraction Tools
6. One (1) – Set Bearing Maintenance Tools
7. One (1) – Set Seal Maintenance Tools
8. One (1) – Set Gearbox Maintenance Tools
9. One (1) – Set Backdrive Maintenance Tools

B. The Centrifuge Manufacturer shall furnish a one (1) year supply of all lubricating oils and greases for the high solids centrifuge equipment assembly equipment furnished under this Section.

C. The Centrifuge Manufacturer shall furnish spare parts for the high solids centrifuge, to include but not be limited to:

1. One (1) set of feed (main) and back-drive bearings and seals;
2. One (1) conveyor (thrust) bearings;
3. One (1) set of seals and O-rings.
4. One (1) set of matched drive belts.
5. One (1) year supply of lubricants
6. One (1) year supply of filters
7. One (1) spare programmed memory card for PLC
8. One (1) each spare analog input, analog output, discrete input and discrete output card
9. One (1) pre-programmed memory card with backup copies of the program
10. Parts as listed for the booster pump

D. The spare parts shall be identical and interchangeable with the original parts, shall be marked with their respective part numbers and furnished in clearly identifiable containers with labels suitable for long term storage.

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SECTION 11432

IN-LINE GRINDERS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, and place in satisfactory operation in-line grinders capable of grinding plastics, rags, scum, screenings, and other matter commonly found in wastewater sludge. Grinders shall be furnished with all necessary accessories, in compliance with the following specifications, and as shown on the Drawings.

B. Equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions.

1.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

A. Grinder Schedule

Quantity	Two (2)
Flow (gpm)	200-400
Solids Concentration (%)	0.75 – 2.5
Maximum Headloss through Grinder, psi	1
Inlet and Outlet Diameter (inches)	6

1.03 SUBMITTALS

A. The following items shall be submitted with the Shop Drawings in accordance with, or in addition to the submittal requirements specified in Section 01300, Submittals; and Section 11000, Equipment General Provisions:

1. Performance Affidavit

1.04 WARRANTY AND GUARANTEE

A. Warranty and Guarantee shall be as specified in Section 11000, Equipment General Provisions.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Grinders shall be suited for continuous use, processing wet or dry, and shall not require an external water source. The in-line grinder units shall be manufactured by JWC Muffin Monster Model 3004T-1206, Boerger Multicrusher Model HFL-776, or approved equal.

2.02 MATERIALS

A. Grinders shall be provided with flanged connections with grinder body of heavy ASTM A536 ductile iron construction. The grinder parts exposed to material to be processed shall be constructed from corrosion resistant materials. Grinder body shall be furnished with handholes on the upstream and downstream sides of the grinding section and a main body drain for clean out purposes.

B. Grinders shall be of a two-shaft design. One shaft speed shall not exceed 40 RPM and the other shall not exceed 80 RPM. The two shafts shall counter-rotate and be equipped with cutters that inter-mesh. The cutters and spacers shall be constructed from 4130 steel hardened to 45-50 Rockwell C, surface ground for uniformity. Each shaft cross-section shall be 2-inch hexagon (across the flats), minimum and shall be constructed from 4140 hardened steel hardened to 45-50 Rockwell C.

C. The cutting mechanism assembly and drive components shall be designed as a single removable cartridge to allow fast replacement. The grinder body shall not require removal to service the mechanical components of the unit.

D. Mechanical seals shall be designed to resist high abrasive conditions and withstand an internal pressure of at least 90 psi. The seals shall be tungsten carbide faced and permanently lubricated. Sealed ball bearings shall be provided at the top and bottom of each cut or stack. The seals shall not require any type of external flush or lubrication.

E. A replaceable planetary or cycloidal type gear reducer designed for continuous service shall be independently mounted between the motor and grinder. The gear reducer shall have a “Heavy Shock” load classification per AGMA standards and be adequately designed for thrust and torque loads imposed under full load conditions with a service factor of 2.0. The high speed shaft of the grinder shall be connected to the gear reducer by a flexible coupling.

F. All sealing component elastomers shall be Nitrile (Buna-N) or EPDM.

2.03 ELECTRICAL AND CONTROL REQUIREMENTS

A. Electrical Requirements

Motors	
Rating	460V, 3 ph, 60 Hz
Maximum Horsepower, hp	5
Speed, rpm	1800
Enclosure	TEFC
Insulation	Class F
Service Factor	1.15
Space Heater	Yes
Motor Winding Temperature Switches	No
Control Panels	
NEMA Rating	NEMA 4X
Materials of Construction	Stainless Steel

B. The minimum motor horsepower specified shall be increased as required if recommended by the grinder manufacturer to achieve the specified capacity. All costs associated with electrical changes for the increased horsepower shall be borne by the Contractor.

C. Electric motors shall comply with the requirements of Division 16. Motor starters shall comply with the requirements of Division 16.

2.04 CONTROL PANEL

A. The grinder manufacturer shall provide a grinder local control panel for each grinder furnished. Tag numbers for each local control panel are provided in Section 2.03A. All components shall be NEMA rated and U.L. listed or recognized. IEC rated devices are not acceptable. All controls, auxiliary contacts, relays, panels, transformers, motor starters, overload alarms, and other ancillary local control panel equipment shall be provided. Local control panel enclosure material and component NEMA ratings shall be in accordance with the table of electrical requirements herein. Control panel components shall meet the applicable requirements of Division 16 and Division 17.

B. Each local control panel (VCP) shall be designed to require only a single 460 VAC three-phase power supply connection.

C. Each grinder local control panel shall be provided with a single circuit breaker type lockable disconnect switch operable from outside the control panel.

D. Each local control panel shall be furnished with a reversing motor starter.

D. Each local control panel shall include the following door mounted controls:

1. HAND-OFF-REMOTE selector switch

2. Indicator lights (RUN, FAULT, HIGH TORQUE ALARM and REMOTE / AUTO)

3. RESET pushbutton.

F. Functional Control Description

1. When the HAND-OFF-REMOTE H-O-R selector switch is in the HAND position the grinder shall operate continuously. When the panel mounted H-O-R selector switch is in the OFF position the grinder shall not operate. When the panel mounted H-O-R selector switch is in the REMOTE position the grinder shall receive a START/STOP command signal as depicted in the interlock on the instrumentation Drawings. The panels shall be provided with pilot relays with 24 VDC coils and auxiliary contacts for the following interface with the centrifuge PLC:

   a. START signal to the panel

   b. Running status to the PLC

   c. FAULT status to the PLC

   d. Grinder In Remote status to the PLC

2. On encountering a jam or overload condition, in either HAND or REMOTE mode, the control panel shall automatically stop and reverse the grinder rotational direction to clear the obstruction. If the jam is cleared, the grinder shall automatically resume normal operation. If the jam condition still exists, the control panel shall go through two (2) additional reversing cycles within 30 seconds (3 times total) before stopping the grinder, activating the grinder HIGH TORQUE alarm, and sending a FAULT status signal to the plant HMI system. For all other grinder failures such as motor overload, a FAULT status signal shall be sent to the plant HMI system.

2.05 SPARE PARTS

A. Manufacturer shall furnish spare parts for in-line grinders at the Fiesta Village WRF in accordance with Section 11000, Equipment General Provisions, to include but not be limited to, the following:

One (1) set of seals.

One (1) set of cutting teeth

PART 3 -- EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 11000, Equipment General Provisions, and shall include the following site visits for each series of grinders:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	1	1
Startup and Training	1	1
Services after Startup	1	1

3.02 SHOP TESTING

A. Shop testing shall be in accordance with Section 11000, Equipment General Provisions and with the following additional requirements:

1. Each grinder and control panel to be furnished for the project shall be shop tested to ensure operation and performance in accordance with these specifications prior to shipment.

- END OF SECTION -

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DIVISION 13

Special Construction

SECTION 13121

PRE-ENGINEERED METAL BUILDING SYSTEM

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, fabricate and install pre-engineered metal building systems where shown on the drawings, complete in accordance with the Drawings and the requirements of the Contract Documents.

B. The manufacturer shall design and fabricate the metal structural system including primary and secondary member connections, purlins, girts, roof and wall panels, bracings, fasteners, connections, sealants, gutters, downspouts, frame openings for louvers, doors and windows, anchor bolts, and all other parts required for a complete installation.

C. All primary framing to be hot dipped galvanized and all secondary framing shall be coated using ASTM A653, G-90 continuous (high-speed) galvanizing process. Galvanized surface coatings damaged during shipping, handling, erection, or due to construction activities shall be repaired in full conformance to ASTM A780 Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of other requirements of these Specifications, all Work specified herein shall conform to or exceed the requirements of the Florida Building Code and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section:

1. Florida Building Code

2. AISC "Code of Standard Practice for Steel Buildings and Bridges."

3. AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings" and including the "Commentary of the AISC Specification."

4. AISC "Specifications for Structural Joints Using ASTM A 325 or A 490 Bolts" approved by the Research Council of Riveted and Bolted Structural Joints of the Engineering Foundation.

5. AWS Structural Welding Code AWS DI.1 and "Standard Qualification Procedure."

6. Metal Building Manufacturer's Association (MBMA) "Metal Building Systems Manual."

7. IAS AC472 Accredited Inspection Program for Manufacturer of Metal Building Systems

8. All the codes and standards listed in the Section entitled "Cast-In-Place Concrete."

1.03 DESIGN CRITERIA

A. Building Description:

1. The building overall dimensions shall be as shown on the Drawings. Column locations shall be as shown on the Drawings unless otherwise accepted by the Engineer. The roof shall have a slope as indicated on the drawings.

2. The Contractor shall coordinate final dimensions of the pre-engineered building and bridge crane with both manufacturers.

B. Design Loads:

1. The metal building system shall be designed for the loads indicated in the Specifications and Drawings.

2. Dead Load shall be the total weight of the metal building. Loads imposed on the building by piping, conduit, and other equipment shall be considered as collateral loads on the structure. The Contractor shall provide all collateral loads to the Building Manufacturer which shall be included in the design calculations for all building components prior to submittal of shop drawings. All piping shall be assumed to be running full of water for design purposes.

3. Roof live load shall be 20 PSF, or greater as required by the Florida Building Code, on the horizontal projection of the roof.

4. Wind load pressure shall be based on a wind velocity of 160 MPH -3 second gust. Wind loads shall be calculated based upon the specified methods in the Florida Building Code and ASCE 7-.

5. Each member shall be designed to withstand the stresses resulting from the combinations of loads that produces the maximum percentage of actual to allowable stress in that member. Allowable stresses for combinations including wind may be increased by 33 1/2%, provided the member thus required is not less than that required for the combination of dead and live load.

6. Load combinations shall be as specified in ASCE 7-10.

1.04 SUBMITTALS

A. The Contractor shall submit shop drawings including manufacturer's erection drawings and design calculations of the metal building, in accordance with the Section entitled

"Submittals." All shop drawings and design calculations shall carry the seal and signature of a Professional Engineer registered in the State of Florida.

B. Shop drawings shall conform to AISC recommendations and Specifications and shall show all openings, etc. required for other Work. Drawings shall include complete details showing all member and their connections, anchor bolt layouts, schedules for fabrication procedures, and diagrams showing the sequence of erection.

C. Manufacturer's product information, specifications, and installation instruction for building components and accessories.

D. Welder certifications shall be submitted for shop and field welders from a recognized testing laboratory or through the AC492 Accreditation Certificate criteria for inspection program for metal building systems.

E. Certification for grade and location of manufacture of all fasteners shall be submitted.

F. A color selection chart from the manufacturer shall be submitted indicating finish color on all exterior wall panels, trims and roof drainage accessories.

G. The metal building manufacturer shall furnish design calculations that demonstrate that the structural framing, roof and wall panels and its connections meet the design loads requirements.

H. The Contractor shall have unit responsibility for coordinating all equipment, piping and ductwork loads, piping and electrical work associated with the building on the design. The Contractor shall coordinate such data as is necessary.

I. Contractor shall furnish the name of erector proposed to use for this work including necessary evidence and/or experience records to ascertain their qualifications in the erection of metal buildings. Proposed building erector's firm or staff experiences shall demonstrate past successful performance for erecting buildings of similar size and scope within the past five years.

J. Florida Product Approvals for all building components and cladding.

K. Data on roof fans shall include catalog data and assembly/installation drawings with illustrations in sufficient detail to serve as a guide for assembly and disassembly. Include information on weight of the assemblies along with the individual weight of any replacement parts such as the motor. Provide verification of roof load bearing capacity to support the assemblies and details on the proposed roof curb for mounting the fans. Provide information on the motor and any electrical / wiring requirements including recommended breaker size for power feed to fan.

1.05 QUALITY ASSURANCE

A. The building manufacturer shall have an ongoing quality control program encompassing materials, fabrication and delivery. The manufacturer shall have been engaged in the design of this type of building for at least five years.

B. Field welds necessary for installation of the building shall be tested by an independent testing firm at the Contractor's expense as follows:

1. Ten percent of all butt and bevel welds less than 24 inches in continuous length shall be tested in accordance with AWS DI.1, Part B, Radiographic Testing of Welds, Chapter 6. Butt and bevel welds more than 24 inches in continuous length shall be similarly spot tested at 36 inch intervals.

2. Welds that fail tests shall be corrected (or redone) and retested at the Contractor's expense.

1.06 WARRANTIES

A. Provide a warranty from the Building Manufacturer stating that all materials furnished for this work is free of defective materials for a period of two years from date of acceptance by the Owner. If defective materials are identified within the two year period, such materials shall be replaced at no additional cost to the Owner.

B. Provide a two-year warranty from the Building Erector that the workmanship in the building erection is free from deficiencies for all connections, sealants, welds, and damage to coatings. Caulking shall not be less than a rating of 8 as per ASTM D 659. In addition, the roof system shall have a guarantee of 10 years against leakage from the Building Erector.

B. The finish of the wall panels and roof panels shall be warranted by the Building Manufacturer for 20 years against blistering, peeling, cracking, flaking, chalking and chipping. Color change shall not exceed 5 NBS units as per ASTM D 2244.

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Structural members shall be loaded in such a manner that they may be transported and unloaded without being over-stressed, deformed, or otherwise damaged.

B. Structural steel members and packaged materials shall be protected from corrosion and deterioration. Material shall be stored in a dry area and shall not be placed in direct contact with the ground. Materials shall not be placed on the structure in a manner that might cause distortion or damage to the members or the supporting structures. Damaged materials or structures shall be repaired or replaced as specified by the Engineer.

1.08 MANUFACTURERS

A. The pre-engineered metal building shall be as manufactured by Dean Steel Buildings, Inc Ft. Myers, FL; United Structures of America, St. Augustine FL; American Building Company, Eufaula, AL; or approved equal.

1.09 STEEL ERECTORS

A. The pre-engineered metal building shall be constructed by Rex Erectors, Dean Steel Erectors, or approved equal.

1.10 COORDINATION

A. The Contractor shall properly coordinate building design and installation with other trades. Supports not supplied by the Building Manufacturer, as well as the support methods for collateral loads shall be coordinated with and approved by the Building

Manufacturer.

PART 2 - PRODUCTS

2.01 STRUCTURAL MATERIALS

A. All structural and covering materials shall be new and meet physical design requirements. All structural steel shall hot dipped galvanized. All fabrication workmanship shall meet the fabrication tolerance as published by the MBMA.

B. Cold-formed sections shall be manufactured by precision roll or brake forming. All dimensions shall be true, and the formed members shall be free of fluting, bucking or waving. Cold formed sections shall conform to the requirements of Specification Section 05010, Metal Materials. All secondary cold formed members shall be coated using ASTM A653, G-90 continuous (high-speed) galvanizing process

C. All structural shapes hot-rolled steel sheets conform to the requirements of specification Section 05010, "Metal Materials" plates and strips of built-up section shall have a minimum yield point of 50,000 psi and be hot dip galvanized.

D. All 14, 15 and 16 gage cold-formed sections shall have a minimum yield point of 50,000 psi.

F. All galvanized sheets and strips for structural framing shall conform to ASTM A 446, Grade "A."

2.02 STRUCTURAL FRAMING

A. Primary Frames

1. Primary framing shall be of rigid connections.

2. Roof beams shall be tapered and columns shall be uniform depth, solid web, welded up plate sections complete for bolted field assembly.

3. All cap plates, compression plates, stiffener plates, and base plates shall be factory welded into place, and have the bolt connection holes shop fabricated.

4. Columns and roof beams shall be shop fabricated, complete with holes in flanges for the attachment of secondary structural members except for field work as noted on the manufacturer's erection drawings.

5. Primary framing shall be tapered beam sections.

B. End Wall Framing

1. End wall structural framing shall be achieved by primary framing specified herein. Channel framing will not be acceptable.

2.03 SECONDARY STRUCTURAL MEMBERS

A. Purlins, Girts and Eave Struts:

1. All steel purlins and girts, shall be “Z” sections either cold formed, hot-rolled, or built-up steel sections having a minimum yield point of 50,000 psi. Outer flanges of all girts and purlins shall contain factory-punched holes for panel connections and for connection to primary frames.

B. Bracing

1. Diagonal bracing shall be provided with rods. Cable type bracing will not be acceptable.

2. All diagonal bracing and sag rods, when required, shall be hot-rolled having a minimum yield point of 50,000 psi. Flange braces, purlin braces and sag rods, when required, shall be cold formed having a minimum yield point of 50,000 psi and be hot dipped galvanized.

2.04 BOLTED AND WELDED CONNECTIONS

A. All field connections in main framing members shall be bolted, using high strength bolts, in accordance with the requirements of ASTM A 325. High strength bolts shall be hot dip galvanized. Field connections between main and secondary framing members shall be made with either ASTM A 325 or A 307 bolts. All ASTM A 307 bolts shall be hip dip galvanized. All bolted connections shall contain at least two bolts minimum.

B. The laying surfaces of all bolted connections shall be smooth and free from burrs or distortions.

C. All shop connections shall be welded in accordance with the American Welding Society "Structural Welding Code." Welding of steel sections shall be submerged arc or gas shielded arc process.

D. Anchorage: The building anchor bolts shall be designed to resist the column reactions. The diameter and layout of the bolts shall be as specified by the building manufacturer. The builder shall provide anchor bolts, anchor bolt setting plans and other information required by the Contractor to set the anchor bolts. Anchor bolts shall be threaded rods conforming to ASTM F 593 Type 316 stainless steel.

2.05 ROOF PANELING

A. The roof panels and connections shall have an Underwriters Laboratories uplift rating of Class 90 and shall be capable of resisting wind, dead, and live load forces as specified in the Article 1.04 entitled "Design Criteria".

B. Roof panels shall be of the ribbed type. The panel material shall be min. 24 gage galvanized steel (or greater to resist specified loads) with a minimum yield of 42,000 psi or Zinc Alloy coated steel conforming to ASTM 792 G90 coating conforming to ASTM A 653. Roof panel interior and exterior shall be painted with a fluoropolymer coating containing 70 percent “Kynar 500”. Roof system shall be PBR ribbed.

C. Panels shall be designed in accordance with AISC "Specifications for the Design of Light Gage Cold Formed Steel Structural Members" and in accordance with the specified loadings.

D. The panels shall be precision roll-framed to provide width coverage of 3-feet minimum.

F. Ridge panels when required shall be one piece, factory covered to match the roof slope.

2.06 WALL PANELING

A. The wall panels and connections shall be capable of with standing wind forces as specified in Article 1.04 - Design Criteria. Wall panels shall be PBR ribbed.

B. The panel material shall be min. 24 gage galvanized steel (or greater to resist specified loads) with a minimum yield of 42,000 psi or Zinc Alloy coated steel conforming to ASTM 792 G90 coating conforming to ASTM A 653. Wall panel interior and exterior shall be painted with a fluoropolymer coating containing 70 percent “Kynar 500”. .

C. The panel design shall be in accordance with AISC "Specification for the Design of Light Gage cold formed steel structural members" and in accordance with sound engineering methods and practices.

D. The panels shall be precision roll-formed to provide a width coverage of 3 feet minimum. The panels shall have at least one major corrugation per foot of 1-3/8-inch minimum thickness and minor corrugations in between to provide rigidity.

E. All wall panels shall be one piece from base to building eave unless otherwise indicated on the Drawings. The bottom end of panels shall be straight cut and shall be sealed with foam closures. All holes shall be factory pre-punched at panel ends to match the pre-punch holes in structural members.

2.07 ROOF AND WALL FASTENERS

A. Panels shall be fastened with stainless steel screws. Roof and wall panels shall be attached to secondary framing members by Zinc alloy ZAC long-life self-drilling screws with weather seal washers.

B. All fastener locations shall be as indicated on the manufacturer's erection drawings.

2.08 ROOF EXHAUST FANS

A. Provide two, roof-mounted up-blast ventilation fans attached to the metal roof. Deliver, store, protect and handle fans in accordance with manufacturer's instructions.

B. Install fans in accordance with manufacturer's data and adhere to all federal, state, and local codes. All work and materials shall be in full accordance with the latest State rules and regulations or publications including those of the State Fire Marshall, the Florida Mechanical and Energy Codes, and all local codes.

C. Manufacturer Qualifications: Manufacturer of fans shall be a company specializing in manufacturing the products specified with minimum five (5) years documented experience, who issues complete catalog data on total product. Fans shall be manufactured by Greenheck Model CUE (Basis of Design), or equivalent as supplied by Cook, Aerovent, or approved equal. All material and equipment shall be the latest design, new, not deteriorated, and the first quality standard product of manufacturers regularly engaged in the production of such material and equipment.

D. Performance ratings: Conform to AMCA standard 211 and 311. Fans must be tested in accordance with ANSI/AMCA Standard 210-99 and AMCA Standard 300-96 in an AMCA accredited laboratory. Fans shall be certified to bear the AMCA label for air and sound performance seal.

E. Classification for Spark Resistant Construction, levels A, B, and C conform to AMCA 99.

F. Fans shall meet ASCE 7-02 Standard and meet the IBC, Florida and Miami-Dade codes.

G. All work shall be performed in a neat and workmanlike manner by workers skilled in their respective trades, and all materials and equipment shall be installed as recommended by the manufacturers and in accordance with specified codes and standards.

H. Touch up and/or repaint to match original finishes all factory finished or painted equipment and materials which are scratched or marred during shipment or installation.

I. Manufacturer's Warranty: Provide manufacturer's standard warranty document executed by authorized company official. The warranty is to be free from defects in material and workmanship for a period of one year from final acceptance. Any units or parts which prove defective during the warranty period shall be replaced including parts and labor.

J. Fan Specifications:

1. Fans shall be furnished and installed complete with all supports, mounting frames, electric drive units and controls, electrical work, and appurtenances ready for operation.

2. Fans shall be securely anchored to supporting members. Fans shall be amply proportioned for the stresses which may occur during operation.

3. Fan discharge air shall be up and away from the mounting surface. Capacity of each fan shall be 6,000 cubic feet per minute (cfm) at a static pressure of 0.5 inches of water gauge, suitable for continuous operation in temperatures up to 400

Fahrenheit (204.4 Celsius).

4. Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number

5. Wheel:

    a. Material type: aluminum.

    b. Non-overloading, backward inclined centrifugal.

    c. Statically and dynamically balanced in accordance to AMCA Standard 204-05.

    d. The wheel cone and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency.

6. Motors:

    a. Motor enclosures: Totally enclosed fan cooled.

    b. Motors shall be premium efficiency heavy duty ball bearing type to match with the fan load, 2 hp, 208/230V, single phase, 12.0 FLA, 1725 rpm.

    c. Mounted on vibration isolators, out of the air stream.

    d. For motor cooling there shall be fresh air drawn into the motor compartment through an area free of discharge contaminants.

    e. Accessible for maintenance.

7. Shafts and Bearings:

    a. Fan shaft shall be ground and polished solid steel with an anti-corrosive coating.

    b. Permanently sealed bearings or pillow block ball bearings.

    c. Bearings shall be selected for minimum L 10 life in excess of 100,000 hours, equivalent to L 50 average life of 500,000 hours, at maximum operating speed.

    d. Bearing shall be 100 percent factory tested.

8. Fan shaft first critical speed at least 25 percent over maximum operating speed.

9. Housing:

    a. Constructed of heavy gauge aluminum includes exterior housing, curb cap, windband, and motor compartment housing. Galvanized material is not acceptable.

    b. Housing shall have a rigid internal support structure.

c. Windband to be one piece uniquely spun aluminum construction and maintain original material thickness throughout the housing.

d. Windband to include an integral rolled bead for strength.

e. Curb cap base to be fully welded to windband to ensure a leak proof construction. Tack welding, bolting, and caulking are not acceptable.

f. Curb cap to have integral deep spun inlet venturi and pre-punched mounting holes to ensure correct attachment to curb.

g. Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators.

h. Breather tube shall be 10 square inches in size for fresh air motor cooling, and designed to allow wiring to be run through it.

10. Vibration Isolation:

    a. Double studded or pedestal style true isolators.

    b. No metal to metal contact.

    c. Sized to match the weight of each fan.

11. Drive Assembly: Direct drive.

12. Roof Curb: Provide roof curb to seal the entire assembly from driven rain.

13. Thermostat: Provide a remote-mounted electronic thermostat mounted in a NEMA 4X enclosure that includes relays with contacts wired to each fan's local switch to turn the fan(s) on when the temperature rises above setpoint if the switch is in the on position. On/Off switch and interface wiring to be supplied under Division 16.

14. Furnish services of a qualified manufacturer's factory trained service personnel to assist in the installation of the equipment, check the installation before it is placed into operation, supervise initial operations and instruct plant operators in the care, operation and maintenance of the equipment. A certificate from the manufacturer relative to these services shall certify that the fan(s) is installed in accordance with the manufacturer's recommendations.

2.09 GUTTERS AND DOWNSPOUTS

A. Manufacturers standard eave gutters and downspouts shall be fabricated from 26 gauge steel with a baked on paint finish to match wall panels.

2.10 SEALANTS AND CLOSURES

A. Polyethylene closed cell closure strips shall be used wherever necessary to insure weather tightness.

B. Roof panel endlaps shall be sealed with a gray elastic compound that equals or exceeds military Specification MIL-C-18969, Type II, Class B.

2.11 ACCESSORIES

A. Accessories supplied by the manufacturer shall include, but not be limited to, the following:

1. Overhang of similar construction as the roof system with soffit panels matching the exterior wall finishes.

2. Sheet metal roof gutters, down spouts and miscellaneous edge flashings with finishes matching the walls.

2.12 FINISHES

A. Color selections will be made by the Owner from the manufacturer's standard Kynar color selection for 24 gage roof and side panels.

B. Finish for structural framing shall be hot dipped galvanized for primary framing and ASTM A 653 G-90 galvanized for secondary framing.

C. Trims, eaves, gutters, down spouts and accessories: Color selected by Owner from supplier's standard color selection chart.

PART 3 -- EXECUTION

3.01 MEASUREMENT

A. The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of Work. The Contractor shall review the Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

3.02 FABRICATION

A. Structural steel shall be fabricated in accordance with the Drawings, AISC Specifications, and as indicated on the final reviewed shop drawings.

B. Materials shall be properly marked and match-marked for field assembly.

C. Where finishing is required, assembly shall be completed including bolting and welding of units, before start of finishing operations.

3.03 CONNECTIONS

A. Shop connections shall be welded or bolted as shown. Field connections shall be bolted except where welded connections are specified. All connections, unless shown otherwise shall develop full strength of members joined and shall conform to AISC standard connections.

3.04 WELDED CONSTRUCTION

A. Pre-engineered Metal Building installation shall be bolted construction. Field welding is to be avoided or minimized when necessary. The Contractor shall comply with the current AWS D1.1 Code for procedures, appearance, and quality of welds and welders, and methods used in correcting welding work.

B. Unless otherwise shown, all butt and bevel welds shall be complete penetration.

3.05 OPENINGS FOR OTHER WORK

A. Openings shall be provided per AISC Specifications, or as indicated for securing other Work to structural steel framing and for the passage of other Work through steel framing members. Torch cut holes will not be permitted.

3.06 ERECTION AND INSTALLATION

A. The erection of the building metal frame system shall be performed in accordance with the building manufacturer's erections drawings and instructions. Erection shall be performed by a qualified erector using proper tools and equipment. The Contractor shall supply a qualified construction supervisor on site at all times during the erection and installation period.

B. Any field modification shall not be made to structural members except as authorized and specified by the building manufacturer.

3.07 SETTING BASES AND BEARING PLATES

A. Prior to the placement of non-shrink grout beneath base and bearing plates, the bottom surface of the plates shall be cleaned of all foreign materials, and concrete and masonry bearing surface shall also be cleaned of all foreign materials and roughened to improve bonding.

B. Loose and attached baseplates and bearing for structural members shall be set on wedges, leveling nuts, or other adjustable devices.

C. Anchor bolts shall be tightened after the supported members have been positioned and plumbed and the non-shrink grout had attained its specified strength.

D. Baseplates of all building support columns shall be raised off the upper slab by at least 3/4” using concrete pads formed with the slab and beveled edges to direct water away from the columns and laser leveled to assure full uniform bearing. Curing of pads shall be complete prior to placing loads on the structure.

3.08 FIELD ASSEMBLY

A. Structural frames shall be set accurately to the lines and elevations indicated. The various members shall be aligned and adjusted to form a part of a complete frame or structure before being permanently fastened. Bearing surfaces and other surfaces which will be in permanent contact shall be cleaned before assembly. Necessary adjustments to compensate for discrepancies in elevations and alignments shall be performed, as necessary.

B. Individual members of the structure shall be leveled and plumbed within MBMA tolerances. The Contractor shall provide and install all temporary bracing required until structure is complete.

3.09 MISFITS AT BOLTED CONNECTIONS

A. Where misfits in erection bolting are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misfit for review by the Engineer. The Engineer will determine whether the remedy is acceptable or if the member shall be refabricated.

B. Incorrectly sized or misaligned holes in members shall not be enlarged by burning or by the use of drift pins. The Contractor shall notify the Engineer immediately and shall submit a proposed method of remedy for review by the Engineer. The Engineer will determine whether the remedy is acceptable.

3.10 MISFITS AT ANCHOR BOLTS

A. Where misalignment between anchor bolts and bolt holes in steel members are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misalignment for review by the Engineer. The Engineer will determine whether the remedy is acceptable. The Contractor shall abide by the Engineer's decision.

3.11 GAS CUTTING

A. Gas cutting torches shall not be used in the field for correcting fabrication errors in the structural framing, except when acceptable to the Engineer. Gas-cut sections shall be finished equal to a sheared appearance.

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SECTION 13209

FIBERGLASS REINFORCED PLASTIC STORAGE TANKS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall furnish, deliver, install, test and place in satisfactory operation fiberglass reinforced plastic storage tanks for chemical service, complete with all necessary accessories at the locations shown on the Drawings and as specified herein.

B. Chemical storage tanks shall be furnished complete with all associated appurtenances such as hardware, anchorage, piping, ultrasonic level indicators, etc., as shown on the Drawings and as specified herein or as otherwise required.

C. It is the intent of this Specification to obtain an installation complete in every necessary detail whether or not covered by the Specification. Any omission of required equipment from the Specification shall not relieve the manufacturer of its responsibility to satisfy this intent.

D. Drawings are for tank dimensions and nozzle orientations only and shall not be used for tank construction.

1.02 CONDITIONS OF SERVICE/STORAGE TANK SCHEDULE

Bulk Sodium Hypochlorite Storage Tank Design Criteria

Number of Units Installed	Two (2)
Approximate Storage Time, days	15
Vendor	IPS, Belco, or approved equal
Type	FRP, Vertical, Single Wall
Material Concentration	12%
Tank Active Volume, gallons	7,000, nominal
Tank Outside Diameter, feet-inches	10’ – 0”
Total Tank Height, feet-inches	14’ - 2”
Level Measurement	Yes

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Shall be as specified in Section 01090, Reference Standards.

B. ASTM C 581 - Chemical Resistance of Thermosetting Resins Used in Glass Fiber Reinforced Structures

C. ASTM C 582 – Contact-Molded Reinforced Thermosetting Plastic Laminates for Corrosion-Resistant Equipment

D. ASTM D 3299-00a – Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks

E. ASTM D 4097-01a – Contact-Molded Glass-Fiber-Reinforced Thermoset Resin Corrosion - Resistant Tanks

F. ASME RTP-1 – Reinforced Thermoset Plastic Corrosion Resistant Equipment

G. All reference specifications, codes, and standards shall be the current version available at the time of Bid.

1.04 SUBMITTALS

A. Submit Shop Drawings in accordance with Section 01300, Submittals.

B. Provide manufacturers list of at least five similar installations of the tank type, size, chemical service, and location conditions being proposed, including date installed, contact name, address and phone number.

C. Submit complete Shop Drawings, Performance Affidavit, Operation and Maintenance Instructions and other information as specified. Required information shall include the total weight of the shipped materials. Shop Drawings shall also include tank dimensions, dimension and location of fittings and attachments, complete handling, storage, erection, installation, and adjustment instructions and recommendations.

D. Submit indication of coordination with all interfaces with related mechanical, structural, electrical and instrumentation and control work. The CONTRACTOR shall be responsible for providing all accessory equipment and all work associated with installation of the equipment.

E. Submit manufacturer's catalog information, descriptive literature, specifications, and materials of construction and chemical resistance. Include complete resin system information. Submit statement that materials and resins used are suitable for intended service.

F. Submit detailed fabrication drawings including design calculations for structural design of tanks, tank supports and tank tie-down and anchor system, signed and sealed by a registered professional civil or structural engineer in the State of Florida. Design calculations shall be submitted with the shop drawing. Submission of design calculations is intended to indicate that the equipment was designed by a qualified individual. Design calculations will not be reviewed by the ENGINEER for completeness or correctness. The design of the tanks shall be the responsibility of the manufacturer.

G. Certification: Prior to installation, furnish an Affidavit of Compliance certified by the tank manufacturer that the tanks furnished under this Contract comply with all applicable provisions of this specification. No tank will be accepted for use in the Work on this project until the affidavit has been submitted and accepted in accordance with Section entitled "Submittals".

H. Submit coupons from nozzle cut outs complete with chain of custody and physical keying of coupons to the shell prior to nozzle attachment. Coupons shall be tested by a third party to verify properties, resin type and fire retardancy.

I. Submit fabricator's detailed requirements for tank foundations and recommended bolt torques for all bolted FRP connections.

J. Submit inspection and testing reports as specified.

1.05 WARRANTY AND RESPONSIBILITIES

A. The tank manufacturer shall be fully responsible for the structural design and integrity and water-tightness of the tanks including all anchorage and connections.

B. The tank manufacturer shall warrant the tanks for materials and workmanship for a period of five (5) years after the completion of the project. Warranty shall be submitted with the Shop Drawings. The tank manufacturer shall replace defective or unsatisfactory tanks during the warranty period at no cost to the OWNER

1.07 QUALITY ASSURANCE

A. Manufacturer: The materials covered by these Specifications are intended to be standard equipment of proven reliability and as manufactured by reputable manufacturers having experience in the production of such equipment.

B. The equipment furnished shall be designed, constructed, and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings and operated per manufacturer's recommendations.

C. The fiberglass reinforced plastic storage tanks shall be as manufactured by IPS or Belco Manufacturing.

D. Qualifications

1. Fabricator's Quality Assurance Supervisor: Minimum of ten year's experience with the fabrication of fiberglass structures. The fiberglass reinforced plastic tank manufacturer shall specialize in manufacture, assembly, and field service of FRP chemical storage tanks with a minimum of ten years experience. The manufacturer shall have at least five (5) U.S. installations of the type, approximate size, and chemical service being proposed, each with a minimum of five (5) years of satisfactory service. The manufacturer shall submit references for the existing installations with shop drawings

2. Designer: Registered professional engineer licensed in the state of Florida

3. FRP Quality Assurance Inspector

a. In-House Inspector shall have a minimum of 5 years as an FRP Inspector

b. Furnish all paperwork and inspection test reports for all FRP tanks

E. The ENGINEER reserves the right to be present at the fabricator's facility for visual inspection and testing of equipment to be supplied.

PART 2 -- PRODUCTS

2.01 MATERIALS AND CONSTRUCTION

A. The Contractor is responsible for the coordination and selection of corrosion resistant materials for the chemical solutions specified below. The fiberglass reinforced plastic storage tank manufacturers shall inform themselves of the characteristics of the specified chemical solutions and guarantee the suitability of the materials used in manufacturing of the tank and appurtenances. The Contractor and manufacturer shall include all features as necessary for satisfactory operation of the tank system for all specified chemical solutions.

B. All tank capacities (volumes) specified shall include only that volume in the straight shell below the overflow pipe invert elevation and above the top of the outlet pipe. At least four inches of freeboard shall be provided between the invert elevation of the overflow pipe and the top of the straight shell.

C. Storage tanks shall be made of materials that can withstand the maximum delivery temperature, if specified. Chemical properties are as follows:

Parameter	Sodium Hypochlorite
CAS Number:	7681-52-9
Storage Concentration:	12.5%
pH:	12.5
Boiling Point, ^{o}F:	220
Specific Gravity:	1.25

D. The CONTRACTOR and tank manufacturer shall be fully responsible for the structural design and integrity and water-tightness of the tanks, including all anchorages and connections.

E. Tanks shall be mounted on level concrete housekeeping pads. Flat bottom tanks shall be provided with a flush bottom drain. The concrete housekeeping pad shall be provided with a notch in the pad to accommodate the flush bottom drain.

F. Resin

1. The resin used shall not contain any fillers, pigments, dyes, or colorants, which may interfere with visual inspection of laminate quality, except as required for viscosity control. The limit of filler shall be 5 percent by weight. No fillers or bulking agents shall be used in the exterior structural layer to decrease the glass loading ratio. Resin pastes used to fill crevices before overlay are permitted.

2. The initiators used will be of the type, manufacturing origin and amounts specified by the resin manufacturer.

3. For fiberglass reinforced plastic storage tanks for sodium hypochlorite service, resin for the interior, corrosion barrier layer shall be Ashland Derakane 411, Hetron 922, or equal. Resin for the structural layer shall be Ashland Derakane 510A, Hetron FR 992 (with 3% antimony pentoxide added to structural layer only), or approved equal and shall conform with a Class 1 flame spread, as specified by the National Fire Protection Agency No. 91.

4. For fiberglass reinforced plastic storage tanks for all other chemicals, resin shall be Ashland Derakane 510A, Hetron FR992 (with 3% antimony pentoxide added to the structural layer only), or approved equal. The resin shall conform with a Class 1 flame spread, as specified by the National Fire Protection Agency No. 91.

G. The reinforcing material shall be a commercial grade glass fiber having a coupling agent which shall provide a suitable bond between the glass reinforcement and the resin and shall be suitable for the fabrication method used. The reinforcing material shall be comparable to that used to generate corrosion resistance.

H. Laminate Construction

1. The laminate comprising the structural tank (bottom, cylindrical shell, top head) shall consist of a corrosion-resistant barrier comprised of an inner surface, interior layer, and a structural (exterior) layer. The tank manufacturer shall provide a resin manufacturer's recommendation which includes the type of veil, plies of veil, and total thickness of the corrosion barrier and any post cure requirements.

2. The inner surface of the tanks shall have two layers of C-glass or Nexus veil for a total of 20 mils. Material used as reinforcing on the surface exposed to chemical attack shall be a commercial grade chemical resistant glass fiber having a coupling agent.

3. The inner surface laminate exposed to the chemical environment shall be not less than 0.02-inch thick, shall be resin-rich, reinforced with chemically resistant surfacing material. The surface shall be smooth, glossy, and free of pits.

4. The interior layer shall be not less than 0.1-inch thick and composed of resin, reinforced only with noncontinuous glass strands applied in a minimum of two plies of chopped strand mat or in a minimum of two passes by the spray-up process. Glass strands shall not be shorter than 1.0 inch or longer than 2.0 inches. Glass content of the inner liner and interior layer combined shall be 27% +/- 5% by weight.

5. Before the reinforcement of the exterior layer is applied, the interior layer shall be allowed to cure completely so that the thickness of the corrosion barrier, consisting of the inner surface and interior layer, will not be reduced. For sodium hypochlorite tanks, BPO-DMA cure system shall be used for the corrosion barrier, and either BPO-DMA or MEKP shall be used for the structural layer resins. MEKP cure system shall be used for the all other chemical tanks. The degree of cure of the laminate, after post cure, shall be such as to exhibit a Barcol hardness on the inner surface of at least 90% of the resin manufacturer's minimum specified hardness for the cured laminate.

6. The exterior layer shall provide additional strength necessary to meet the tensile and flexural requirements. The reinforcement shall be filament wound, contact molded or a

combination of both and may consist of continuous roving, woven roving, chopped strand mat or chopped strands. Where separate layers of reinforcement are used, all layers shall be lapped a minimum of 1.0 inch. Laps shall be staggered as much as possible. If woven roving or cloth is used in successive layers, it shall be alternated with a layer of chopped strand glass.

7. The thickness of the filament wound portion of the tank shell may vary with tank height, provided that all stress and other requirements are met at any height level.

8. Glass content of the exterior layer shall be 60 to 80 percent by weight. All reinforcement used shall be resistant to corrosion by the particular chemical stored in the tank.

9. Sandwich-type laminate construction, containing fillers such as foams, balsa or any other, shall not be accepted.

10. The outer surface shall consist of chopped strands or surfacing mat, or both, over which shall be applied a resin-rich coating. The outer surface shall not be pigmented, painted or dyed except to prevent ultraviolet degradation of the tank contents or unless noted otherwise. This surface shall be at least 0.02 inch thick.

11. All joints between tank components shall be covered by lay up. Internal joints shall be provided with a resin-rich surface veil overlay, reinforced with chemically resistant surfacing material.

12. Tanks shall be dry heat post cured in accordance with resin manufacturer's guidelines.

13. The tank top shall be flat with openings and connections as shown on the Drawings and specified herein. The tank top shall be able to support a 250-pound load on a 4-inch by 4-inch area. Tank bottom shall be seamless.

U. Structural Design:

1. The CONTRACTOR shall assign to the FRP tank manufacturer full responsibility for the complete structural design of each FRP tank. All tanks located outdoors shall be designed for anchorage and wind loads in accordance with the latest edition of the Florida Building Code.

2. For tanks installed outdoors, tanks shall be capable of withstanding the lateral windloads specified in Table 13206-1. Design for wind load shall follow the latest edition of the Florida Building Code. Mounting lugs for all tanks installed outdoors shall be adequate to withstand these windloads.

4. All tanks shall be capable of withstanding a surcharge of 12 inches water column when full and an under pressure of 6 inches water column when empty.

2.02 CONNECTIONS AND ACCESSORIES

A. Connections: All flanged nozzles shall be of hand lay-up construction with pipe stub molded integrally with the pipe flange. All connections/openings shall be flanged in accordance with

ANSI B16.5 Class 150 and provided with flanged gasket. Flanged connections, nozzles, and openings shall be FRP gusseted and flat face.

B. Nozzles: All nozzles (except drains) shall project into the tank a minimum of 2" or one half the diameter of the nozzle, whichever is greater, unless noted otherwise.

C. Fill Lines: Tank fill lines shall be as shown on the Drawings. All pipe supports, hardware, accessories, etc., shall be provided. Vertical piping into the tanks shall be supported every five feet and shall be parallel to the tank wall and not less than 6 inches from the tank wall.

B. Pump Suctions: Metering pump suction lines shall be as shown on the Drawings. All pipe supports, hardware, accessories, etc. shall be provided. Metering pump suction connection shall be a siphon drain connection.

C. Pipe Supports and Piping: All pipe supports, hardware, accessories, etc. shall be provided. Vertical piping into the tanks shall be supported every five feet and shall be parallel to the tank wall and not less than 6 inches from the tank wall. All piping into the tanks shall be supported such that no weight is placed on the tank and its connections. Piping supports requiring holes through the side wall of the tanks shall not be allowed. Recirculation pump suction connection shall be a siphon drain connection. All supports, hardware, and accessories shall be fabricated from materials resistant to chemical corrosion by the chemicals being contained in the respective tank.

F. Flexible Connector: Each tank shall be provided with a flexible connector for each connection located at the bottom of the tank which shall be resistant to the specified chemical to allow for expansion and contraction of the tank and to isolate the tank from vibration. Flexible connectors shall be provided by the tank manufacturer.

G. Vent Lines: Vent lines shall be top-mounted. Each vent shall be extended to the atmosphere and shall have a 180 degree return and a fiberglass vent insect screen. Vent lines shall be supplied and furnished by the CONTRACTOR as required or as directed by the ENGINEER. Vent lines shall be as specified herein and as indicated on the Drawings.

H. Overflow and Drain Lines: The tanks shall be provided with an overflow and drain pipe as specified and as indicated on the Drawings. Drain line shall be as indicated on the Contact Drawings. Drain connection shall be siphon drain connection. Each drain line shall be provided with a ball valve (vented ball valve for hypochlorite service).

I. Flange Insert Check Valves: The CONTRACTOR shall provide Flange Insert Check Valves (FIV's) for interior storage tanks as shown on the Drawings. The FIVs shall be installed on the overflow lines and shall be complete with unions, liquid traps, and flanges as indicated in the Drawings. The valves shall be as specified in Section 15105 entitled "Check Valves".

J. Quick Connect Couplings: The storage tank fill line shall be provided with a camlock type quick connect coupling with an integral check valve. The quick connections shall be provided between the delivery vehicle and the chemical storage tanks as shown on the Drawings. The quick connections shall be resistant to corrosion by the specified chemicals and shall be provided with fittings, quick lock coupling and dust cap and chain.

K. Level Sensor: The bulk and day tanks shall be provided with a level sensor in accordance with Division 17. The mounting and connecting requirements shall be coordinated with the instrument supplier.

L. Sight Level Indicators: The tanks shall be equipped with a visual liquid level indicator fabricated from clear SCH 80 PVC pipe and provided with inlet and outlet isolation ball valves off the tank nozzles.

M. Manways**:** All bulk storage tanks shall be provided with flat-faced flanged manway at the top of the tank with gasket and blind flange that are chemically resistant for internal access. Flange hardware shall be resistant to corrosion by the specified chemicals. Manway flanges shall conform to NBS PS 15-69 25 psi class dimensions.

N. Lifting Lugs: The tank shall be provided with a minimum of four lifting lugs, three of them around the top edge of the tank and one at the base of the tank. Lugs shall be fiberglass encased Type 316 stainless steel. Lifting lugs shall be capable of withstanding weight of an empty tank with a safety factor of 3 to 1.

P. Tie-Down Lugs: Each tank shall be provided with a minimum of six tie-down lugs and all necessary anchor bolts. The tank shall withstand horizontal loadings of 40 pounds per square foot, and a 140 mph wind load. Tie-down lugs shall be capable of withstanding buoyancy of empty tank in a flooded containment area. Refer to Drawings for containment wall height. The tank manufacturer shall submit calculations to verify that tie-down lugs can withstand buoyance and wind load.

Q. Certification Label: The tank shall be provided with a permanently attached label providing the following information:

1. Type of material stored
2. Concentration of material stored
3. Specific gravity
4. Maximum temperature
5. Type of liner resin and reinforcement
6. Type of surface veil
7. Tank capacity
8. Manufacturer
9. Date of manufacture

R. Signage: Each tank shall be provided with a sign to identify chemical stored. Signs shall be attached to the tank at locations that are clearly visible or as directed by the ENGINEER. Sign layout shall conform to NFPA diamond sign customized for the stored chemical.

S. The storage tank fill line manifold for both tanks shall be provided with a quick connect coupling and isolation ball valve as shown on the Drawings. The dry quick connections shall be resistant to corrosion by the specified chemicals and shall be provided with fittings, quick lock coupling and dust cap and chain.

T. All parts, fasteners, brackets, mounting hardware, and accessories provided by the tank manufacturer shall be constructed of corrosion resistant non-metallic materials or fully encapsulated metal if needed for reinforcement.

2.04 PIPING SUPPORT

A. All horizontal sections of piping inside the containment area and trench shall be supported by thermoplastic pads at maximum 5 foot intervals as shown in the Drawings to prevent the piping from resting directly on concrete.

B. For vertical piping exterior and interior to the tank, all pipe supports, hardware, accessories, etc., shall be provided for connections as shown in the Tank Schedule. Vertical piping into the tanks shall be supported every five feet and shall be parallel to the tank wall. External vertical piping shall be not less than 6 inches from the tank wall. Support locations for piping installed within the tank shall be coordinated with equipment to be installed within the tank and shall be as shown in the Drawings. All piping into the tanks shall be supported such that no weight is placed on the tank or its connections.

PART 3 -- EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 11000, Equipment General Provisions and shall include the following site visits for the tanks:

Service	**Number of Trips**	**Number of Days/Trip**
Installation, Inspection and Testing	1	1
Final Inspection/Startup and Training	1	1

B. The manufacturer's technical representative shall adequately supervise the installation and testing of the tanks and instruct the OWNER's operating personnel in its maintenance and operation.

C. The times specified are exclusive of travel to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.

D. Any additional time required to achieve successful installation shall be at the expense of the CONTRACTOR.

3.02 INSTALLATION

A. The Contractor shall furnish and install the Fiberglass Reinforced Plastic storage tanks, and related items in accordance with the manufacturers' recommendations and in accordance with Section 11000, Equipment General Provisions.

B. A manufacturer's field representative shall be on site when each tank is installed to observe installation and verify that each tank has been installed per manufacturer's recommendations. The manufacturer shall provide a report certifying that each tank has been installed properly.

C. All piping, valves, fittings, conduit, wiring, etc., required to interconnect system components shall be furnished and installed by the Contractor. Unless otherwise noted, piping shall be Schedule 80 CPVC.

D. The Contractor shall install a minimum of 2 layers of roofing felt between each concrete pad and storage tank. The tanks shall be installed on level pads.

3.03 INSPECTION AND TESTING

A. A 3-stage inspection process shall be performed on the tank during various stages in the construction process. The first inspection shall be performed at the completion of the corrosion barrier and before structural winding occurs. The second inspection will be performed after the tank is removed from the mandrel and before any nozzles are attached. The third inspection shall be a final inspection prior to shipment of the tank. These inspections shall be performed by an independent inspector with at least 5 years of experience with FRP vessels.

B. Field testing shall be performed in accordance with Section 11000, Equipment General Provisions.

C. Upon completion of installation of tank and prior to connecting piping, the Contractor shall provide blind flanges or other suitable plugs for all openings in the tank, fill tank with potable water from a source approved by the Engineer and conduct a leakage test. Tank shall be filled up to the top of the straight shell and left to sit over a 5 consecutive day test period. There shall be no leakage over the test period. Upon satisfactory completion of leakage test, Contractor shall drain the tank and dispose of water in a suitable manner.

D. Quality control for visual defects shall be as shown in table below. Corrosion liners requiring rework in excess of 1% of the surface area of the component shall be cause for rejection.

Maximum Allowable Visual Defects Quality Level 1		
Visual Defect	**Corrosion Liner**	**Structural & Finish Layers**
Air Bubbles - Bubbles trapped within, on, or between plies. (0.015" dia. and larger) Not to be confused with froth.	None allowed between veil and antiwicking barrier. (Test with pencil point) Max. 1/16" dia., 2 per in2, averaged over 1 ft^2 area. In no case, more than 4 per in^2.	Practically achievable but not larger than 1/4" dia. Total combined area of all air bubbles not to exceed 10 in^2 per yd^2 for laminates up to 1/2" thick, and increased proportionately for thicker laminates. In no case more than 4 bubbles per in^2.
Blisters - Rounded surface elevations resembling a human skin blister.	None allowed	3/16" dia 1/16" height 1 per yd^2

Burned Areas - Dark discoloration and distortion of the laminate from excessive curing temperature.	None allowed	None allowed
Chips - Small pieces broken off an edge or surface of the laminate.	None allowed	1/8" dia. 1 per yd^2 1/16" deep
Cracks - Material separation or fracture.	None allowed	None allowed
Crazing - Fine cracks at or under the surface of the laminate.	None allowed	1" dia. 1 per yd^2 1/64" deep
Delaminations - Separation of the layers of material in a laminate.	None allowed	None allowed
Dry Spots - Area of surface where the reinforcement has not been wetted with resin. Not to be confused with glinting.	None allowed	None allowed
Edge Delamination - Separation of the reinforcement layers at the edge of the laminate.	None allowed	None allowed
Foreign Inclusions - Anything other than raw material components (visible with naked eye)	None exposed to surface. (must be covered with resin)	Practically achievable, but not more than 1/4" dia. and 3 per yd^2.
Pits - Small craters in the surface of the laminate.	1/16" dia. 2 per yd^2 1/32" deep	1/8" dia. 4 per yd^2 1/16" deep
Surface Pinholes - Numerous visible pinholes in the surface of the laminate.	No exposed surfacing veil.	Not applicable
Scratches - Shallow marks or grooves caused by mishandling the laminate.	None allowed	1/32" deep 6" long
Wrinkles - Linear, abrupt change in surface plane due to overlap in reinforcing layer, irregular mold surface, or wrinkled release film, resulting in a resin rich area that could be easily chipped. Waviness is allowed provided it does not result in resin rich area.	1/8" but must not decrease the laminate thickness below allowable.	Not applicable

E. After the tank has completed a successful hydrostatic test, the tank shall undergo a mechanical integrity test using Acoustical Emission Test (AE Test) in accordance with the latest version of ASTM E 1067. The Contractor shall secure the services of Non-Destructive Evaluation International (Davidson, NC) or an equally qualified firm to perform the AE testing. Firms shall be considered equally qualified by demonstrating the following:

1. The firm shall specialize in AE testing.

2. The firm shall have all necessary equipment to perform AE testing.

3. The firm shall have a minimum of five (5) years experience in AE testing and shall provide a list of AE tests performed to demonstrate experience.

4. The firm's testing staff shall have a minimum of five (5) years experience with AE testing.

Contractor shall provide all labor and materials necessary for completing AE testing including water to fill tanks with during testing. After testing is completed, a final report shall be submitted to the Engineer. In the event the AE test results indicate repairs are required; the tank manufacturer shall promptly repair all faulty areas of the tank as identified by the test. The tank shall then be re-tested using the hydrostatic test and the AE test. The second AE test report shall be submitted to the Engineer. Any tank failing the second hydrostatic test or the AE test shall be removed from the project site and replaced with a new tank at no cost to the Owner. The replacement tank shall undergo hydrostatic and AE testing and shall be subject to the same acceptance criteria as the initial tank. This process shall be repeated until all tanks provided to the project pass the AE test.

3.04 CHEMICAL FILLS

A. The CONTRACTOR shall furnish all chemicals in sufficient quantities as necessary to successfully complete startup of the new hypochlorite storage and feed system. Chemicals supplied shall be through the County's existing bulk chemical supply contractor.

B. Following successful completion of startup and testing, the County will order chemical as needed to place the system in service.

- END OF SECTION -

SECTION 13400

PRECAST CONCRETE BUILDINGS

PART 1 -- GENERAL

1.01 DESCRIPTION

A. Scope of Work: Furnish all materials, equipment and incidentals required to install a new precast concrete building to serve as the electrical building with interior dimensions nominally 24 feet long by 12 feet wide, with minimum 10-foot ceiling height. Building shall include concrete walls, ceiling, and floor suitable for installation on a Contractor provided elevated concrete slab as shown on the Drawings.

B. Contractor may elect to construct building of concrete masonry units, concrete floor, and hollow core slab ceiling with an integral built up membrane roof that meets all the criteria and is equal to the specified precast concrete building. However, the Contractor would be responsible for the design of the building and submit drawings and calculations signed and sealed by an active registered Florida PE and obtain all building permits related to the construction of the building.

C. Work shall include all reinforcements, trim, roofing, light fixtures, receptacles, dual air conditioning units, lighting panel, concrete pads for electrical equipment, and prewired conduit and cable for connection to building supplied devices as shown and required for a complete installation. All devices supplied with the building shall be factory set and installed other than the outside dual air conditioner condenser units which shall be shipped separately. Other electrical components, including the MCC, VFDs, lighting panel transformer, and ATS shall be supplied, installed, and field wired under Division 16 after the building is set in place, as well as the centrifuge PLC panel supplied under Division 11.

D. General Design:

1. Loading Design Standards: The structure shall be designed to meet the requirements of loading of the American National Standards Institute (ANSI) “Building Code Requirements for Minimum Design Loads in Buildings and Other Structures,” the Southern Building Code, and the requirements of the American Concrete Institute (ACI -318R) “Building Code Requirement for Reinforced Concrete.”

2. Design Criteria: The building design will meet or exceed the following minimum loadings:

a)	Roof Live Load	60 PSF
b)	Roof Snow Load	10 PSF
c)	Floor Live Load	100 PSF
d)	Floor Dead Load	75 PSF
e)	Wall Wind Load	Nominally 140 MPH, sufficient to meet FBC

f) Earthquake Zone 3 or 4

3. Anchoring: The building shall be set on a fully cured, level, elevated concrete slab constructed by the Contractor as shown on the Drawings. The final floor elevation of the building shall be set a minimum of 5 inches above the Contractor provided slab (thickness of floor slab provided with the building). Contractor shall coordinate with the building manufacturer for anchoring of the building to the Contractor provided elevated slab using epoxy adhesive dowels set in the Contractor provided slab into preset receiver holes in the building slab/walls. Exposed metal clips are not allowed. Anchoring shall be sufficient to meet all current Florida Building Code requirements.

4. Vandal Prevention: The building shall be highly vandal resistant. The building envelope shall be bulletproof to a 308 rifle and steel bullet at 50 feet.

5. Shipping and Handling: The building shall be designed to be handled and off loaded with an appropriate capacity crane using standard pickups in the roof of the structure.

6. Construction and Dimensions: The precast concrete building design shall be such that the floor, walls and roof are monolithic at manufacture, with end walls attached. The precast concrete building dimensions and door opening size shall be adjusted by the Contractor to adequately install and house the electrical equipment. In addition to allowing for installation of the electrical equipment, the dimensions shall meet electrical code clearance requirements for the equipment.

7. Quality and Fire Rating: Manufacturer shall maintain a continuous quality control program, and shall submit to the Engineer certified results of the physical test results for concrete and reinforcing. The building shall have a 2 hour fireproof rating without affecting the structural integrity of the building.

1.02 QUALITY ASSURANCE

A. Codes and Standards

1. Use the following where applicable in design:

a) Building Design - American National Standard (ANS) “Building code Requirements for Minimum Design Lands in Buildings and Other Structures.”

b) Electrical Design - The National Electrical Code/1990.

c) American Concrete Institute - ACI-318R “Building Code Requirements for Reinforced Concrete.”

d) Building Code and regulations of other governing authorities having jurisdiction at the project site.

e) Applicable standards of the American Society for Testing and Materials (ASTM).

f) Ratings by Underwriters Laboratories (UL) and Factory Mutual Research (FM) as required.

B. Equipment Manufacturer: The equipment shall be designed, constructed and delivered with the best practices and methods and shall be as manufactured by Oldcastle Precast, Inc. of Cape Coral, Florida; or approved equal.

1.03 SUBMITTALS

A. Materials and Shop Drawings: Copies of all material required to establish compliance with the Specifications shall be submitted in accordance with the provisions of the General Requirements. Submittals shall include at least the following:

1. Design Calculations and Erection Drawings: Prepare submittal under the direct supervision of a registered Professional Engineer, licensed to practice in the State of Florida with all drawings and calculations bearing his seal and signature.

2. Shop Drawings: Submit shop and erection drawings that show all important details of construction; dimensions; door and air-conditioner locations; lighting, electrical device locations; conduit size and locations; electrical equipment concrete pads dimensions and locations, and conduit and air-conditioning system wall penetration size and locations.

3. Certification: Submit written certification, prepared and signed by a Registered Professional Engineer licensed to practice in State of Florida, attesting that the building design meets specified loading requirements, requirements of codes and authorities having jurisdiction at project site, and other requirements specified.

4. Equipment Data: Descriptive literature, bulletins, and/or catalog data of materials and equipment furnished with the building. The total weight of the assembled building and complete total bill of all materials and equipment supplied with the building.

B. Non-Conformance Notification: In the event that it is impossible to conform to certain details of the specifications due to different manufacturing techniques, describe all non-conforming aspects.

1.04 DELIVERY, STORAGE AND HANDLING

A. Delivery: Precast concrete building shall be field installed according to the manufacturer's instructions. A factory representative shall be available to assist during installation of the building. The separately shipped outdoor dual air conditioner

condenser units shall be installed by the Contractor in accordance with the building and air conditioner manufacturers' recommendations.

B. Storage and Handling: Building and equipment shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of fabrication until ready for shipping and installation. The building shall be off-loaded at the site and immediately set in place (no on-site storage time shall be allowed). All equipment and components of the building shall be properly protected against any damage after installation and during installation of the electrical gear. Each box or package of loose material shall be properly marked to show its net weight in addition to its contents.

1.05 WARRANTY AND GUARANTEES

A. All buildings, components, materials and equipment supplied under this section shall be warranted for a period of two years by the building manufacturer and the Contractor. Warranty period shall commence on Owner acceptance as outlined in the General Requirements. The materials and equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the materials and equipment should fail during the warranty period, it shall be replaced and the unit restored to service at no expense to the Owner.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Furnish and install the precast concrete according to the manufacturer's written instructions. All materials shall be of a quality to withstand corrosion, stresses and sunlight. All materials and equipment provided by the precast concrete building manufacturer shall be guaranteed to be compatible as a total system. Any required variance of the manufacturer's standard product shall be approved by the Engineer before installation.

2.02 PRECAST CONCRETE BUILDING

A. Concrete: Concrete and reinforcing to construct the building shall be in accordance with Division 3. Concrete shall have a compressive strength of 5,000 psi in 28 days. Minimum thickness for walls shall be 5 inches, the minimum thickness for the floor shall be 8 inches, and the minimum thickness for the roof shall be 5 inches at lower edge and 7 inches at the higher edge (entry door side).

B. Roof and Ceiling: The building roof shall be designed as a clear span without the use of interior supports of any type. The building interior ceiling finished height shall be 10 feet minimum. Building roof shall be of concrete completely sealed with the building walls.

C. Assembly: The building shall be manufactured with a mechanism for assembly under tension at the factory with all joints caulked with a Tremco Dymonic compound (or

approved equal) to maintain a permanent water-tight seal under severe weather conditions.

D. Exterior Wall and Roof Finish: The building exterior walls and roof finish shall be a smoothed, rubbed finish, suitable for field coating specified under Section 09900. It is the intent to have the building exterior coated in the field by a painting subcontractor to have the same manufacturer and color utilized for the rest of the dewatering structure's concrete frame. Manufacturer to provide a factory applied prime coat as needed to best promote superior adherence of the final field coats. Contractor to coordinate actual requirements of coating systems between the manufacturer and the painting subcontractor.

E. Interior Wall and Ceiling Finish: The interior of the building shall be insulated on the walls and ceiling behind a factory installed gypsum wall board finish. Insulation shall have an R rating of 14.4 and shall have a maximum thickness of 2 inches. The interior walls and ceiling shall be finished using 5/8-inch thick, fire rated gypsum Type X wall board. The interior walls and ceiling of the building shall be factory primed and finish coat painted with a coating system for gypsum wallboard surfaces as specified in Section 09900 prior to factory installation of any equipment. Touch up paint shall be delivered with the building to correct any damage to the coating prior to final acceptance. It is the intent to have the building interior factory coated to provide a complete and continuous finish throughout the interior prior to installation of factory installed electrical and air-conditioning equipment.

F. Floor Finish: The building concrete floor and equipment pads shall be finished with a smooth concrete finish suitable for field coating with an epoxy paint finish as specified in Section 09900. Floor shall be field coated after installation of the building and prior to installation of electrical equipment not supplied with the building. Contractor shall protect the finish floor coating with suitable plastic sheets through final acceptance of the project. It is the intent to have the building floor coated in the field by a painting subcontractor to have the same manufacturer and color utilized for the rest of the dewatering structure's concrete upper floor. Manufacturer to provide a factory applied prime coat as needed to best promote superior adherence of the final field coats. Contractor to coordinate actual requirements of coating systems between the manufacturer and the painting subcontractor.

2.03 DOORS AND FRAMES

A. Doors: Doors shall be 1 3/4-inch thick aluminum flush doors as manufactured by Cline Aluminum Doors or Endure-A-Door Model 620 Institutional. The door core shall be honeycomb material 80 lbs. per 3,000 square foot ream with a 7/16-inch cell size and impregnated with 20 percent phenolic resin. A 1 1/4-inch by 4 inch by 1/8 inch thick 6063-T5 aluminum alloy tube shall be provided on all four sides of the door. Door facing shall be 0.40-inch thickness, smooth surface finish, aluminum sheet laminated to a 0.125-inch thick tempered hardboard. Entire perimeter of door shall be furnished with a special beveled design using 6063-T5 aluminum alloy extrusions.

B. Wood Blocks and Hinges: Wood blocks for attaching door hardware except hinges and door closers shall be the highest quality fir kiln dried treated with wood life.

Wood blocks shall be the full thickness of the door. Reinforcement for hinges and door closers shall be provided using a 5/16-inch thick aluminum reinforcing bar. Door hinges shall be stainless steel. All tapped holes for mortised hardware shall be made at the factory.

C. Fasteners and Gaskets: Screws, nuts, washers, bolts, rivets, clips and other miscellaneous fastening devices shall be of aluminum or stainless steel. Gaskets for exterior doors shall be elastomeric vinyl with color to match anodized aluminum color. Pairs of doors shall be equipped with an astragal on the inactive leaf.

D. Frames: Door frames shall be furnished by the door manufacturer and shall be constructed of 6063-T5 aluminum alloy extrusions. Wall thickness of the frame shall be 0.125-inch. Weather-stripping shall be elastomeric vinyl with color to match anodized aluminum color. Door rabbets shall allow for 1 3/4-inch door and weather-stripping. Weatherstripping shall create a weathertight seal when door is installed properly. Door frame corners shall be cut square and fastened together using stainless steel screws and extruded corner brackets. Hinge and door closer reinforcement shall be provided using a 1/4-inch thick aluminum plate drilled and tapped to receive hinges and closer brackets. Openings for mortise lock strike plates shall be drilled and tapped.

E. Color and Finish: Door and frame shall be integral color anodized, NAAMM AA-M21C22A42, with a minimum thickness of 0.7 mils. Color shall be dark bronze No. 313. A protective coating of clean, non-yellowing lacquer with a minimum thickness of 0.5 mils shall be applied by the manufacturer over all anodized surfaces. Lacquer shall be specifically for protection of anodic coatings.

F. Vision Panels: Vision panel openings (one for each pair of doors, nominally 6 inches wide x 3 foot high) shall be reinforced glass. Moldings shall be mitered and welded into a continuous frame with the exterior side frame welded in place and the interior frame secured with anodized aluminum countersunk screws. Glass for vision panels shall be clear, 1/4-inch thick tempered safety glass conforming to Federal Safety Standard 16CFR1201. Setting blocks and spacer shims shall be fabricated from neoprene. Vinyl sealant used for glazing shall have color to match anodized aluminum color.

2.04 HARDWARE

A. Manufacturers: Catalog numbers refer to Russwin, Corbin, Stanley and Ives and are for the purpose of establishing equality. The products of Schlage, Hager, Sargent, LCN, Yale, Norton, Pemko, Reece and Zero shall be acceptable as approved alternates for the named products. Submit hardware schedule.

B. Hardware Requirements:

1. Materials: All hardware shall be new and free from defects affecting serviceability or appearance. All working parts shall be well fitted and smooth working. All hardware shall be made of materials as called for. Hardware shall be furnished complete with all fastenings. Box strikes for all metal

frames shall be furnished complete with all fastenings. Finishes shall be US32D, Satin Stainless Steel, except where noted otherwise.

2. Templates: Hardware application to metal shall be made to standard templates. Template information shall be furnished to door and frame fabricators and other trades requiring same, in order that they may cut, reinforced or otherwise shop prepared for receiving hardware. The Contractor shall be fully responsible for checking all details such as wall trim clearance, bevels, rabbets, backsets, etc., in order that all items of hardware shall fit properly.

3. Locksets and Keying: Complete locksets shall be supplied from a single manufacturer. The Owner's existing lockset system shall be used for the precast concrete buildings. All keys shall be keyed to the Owner's existing keying system. Provide six sets of keys.

4. Knox Box Emergency Access: Furnish fire department Knox Box for emergency entry access mounted to exterior of building adjacent to control room door. Knox Box shall be Model 3502 complete with spare key to unlock door.

5. Hardware Schedule: All door sizes, materials, swings, etc. shall be coordinated with the equipment provided. Hardware listed is for each door. Total quantities required shall be determined from the number of doors supplied but a minimum of two doors are required for ingress and egress from opposite sides of the building per code. Double doors shall be supplied where shown on the Drawings for installation or maintenance of equipment.

Quantity	Hardware Description
1 1/2 pr.	Butt Hinges, Hager No. BB 1191, 4 1/2 x 4 1/2, US32D.
1	Lockset as noted above with crossbar interior panic exit device, US32D.
1	Closer, Corbin/Russwin DC2210 with parallel arm offset angle bracket and full non-metallic cover, silver aluminum lacquer finish. No through bolts.
1	Continuous Threshold, Hager No. 520SN with neoprene insert, extruded aluminum.
1	Overhead Door Holder, Corbin/Russwin No. DH5401, US26D. No through bolts allowed.

2.05 AIR CONDITIONER/HEAT PUMPS

A. Pre-fabricated building shall have dual air-conditioning units suitable to cool the building as located in South Florida to maintain a 60 to 80 degree inside temperature throughout the year. Cooling capacity shall be sufficient to dissipate and compensate for the heat output produced by the VFD's supplied and other electrical equipment located inside the building. Supply air capacity, evaporator exterior static pressure, MBH total/sensible cooling capacity, and kw of electric heater shall be as recommended by the building manufacturer. The units shall operate on 208/230V, single phase, 2-pole power supply from the building lighting panel.

B. Provide a multifunction wall mounted programmable electronic thermostat(s) located in the mid-span of the building to control both units. Controls for the two A/C systems shall be as shown on Sheet E-21 of the Contract Drawings to provide lead/lag duty for the units on separate temperature settings, lead/lag alternation based on a 7 day time clock, Hand/Off/Auto switches for both units, and alarm contacts for a signal to the PLC in case of another separate high temperature setting.

C. Units shall be split system type with wall mounted air handling units factory installed on opposite ends of the building above the height of any electrical gear. The outside condenser units shall be installed on the building's sloped roof above the associated air handler unit on Type 316 stainless steel or aluminum supports to level the units. Units shall be as manufactured by Mitsubishi, Model MSY air handler and Model MUY condenser, or approved equal.

D. Capacity of the units shall be a minimum of 2 tons (24,000 btu/hr) for each unit. Combined capacity of the two units shall be sufficient to dissipate heat heat loads from equipment supplied by the building manufacturer, heat output of the electrical equipment supplied under Division 16 (estimated to be 7,000 watts), heat output of the PLC panel supplied under Division 11, plus the expected heat load from exterior exposure to indirect sunlight and ambient temperatures associated with Southwest Florida.

E. Outdoor condenser unit shall be treated with anti-corrosion coating on coils and hardware suitable for a waste treatment facility environment. Coating shall be an aftermarket Lee County standard coating as provided by Bethel Coatings of Cape Coral, Florida, (954)636-2645 for new condenser systems. Contractor shall make arrangements to have the condenser units shipped to Bethel Coatings to have this coating applied prior to installation.

F. Contractor shall install the roof mounted condenser units in the field after installation of the building, securely fastening the units to the roof following all recommendations of the building manufacturer. The building manufacturer shall provide factory installed conduit and coolant piping within the building interior ready for final field installation of the condenser units. The Contractor shall make field connections for the condenser units for electrical power and coolant lines, supplying all field wiring and piping as needed for fully function systems. The Contractor shall provide SCH80 PVC drain lines from each unit down to grade that discharge into a Contractor provided dry well pit.

2.06 ELECTRICAL WORK

A. Materials: Electrical work shall be in accordance with Division 16 and as specified herein. Conduit shall be rigid aluminum conduit of 6063 alloy in temper designation T-1 meeting U.L. 6A and manufactured to ANSI C80.5. Provide threaded aluminum conduit fittings, of the same 6063 alloy, cast aluminum with integral insulated throat as manufactured by Allied, OZ Gedney, T&B, Crouse-Hinds, Killark or Appleton Conduit supports shall be aluminum or Type 316 stainless steel with Type 316 stainless steel hardware. Aluminum conduit in contact with concrete shall be coated per Section 09900.

B. Wall duplex receptacles (three interior, one exterior) and light fixture switches (one adjacent to active leaf door) as noted on the Drawings installed in wall mounted, corrosion resistant plastic or aluminum boxes with satin finished, stainless steel cover plates. Exterior duplex receptacle shall be GFI type and all duplex receptacles shall be rated at 20 amperes and comply with UL 943, Class A. Locate receptacles in coordination with approved electrical equipment layout to allow access to and easy use of each receptacle.

C. Provide interior light fixtures as shown on the Drawings (four overhead lights and one exit light over the door). Overhead lights shall be ceiling-mounted, 10” x 2.75” x 48” wrap around LED light fixtures with curved acrylic prismatic diffuser, steel construction, polyester enamel highly reflective white coating, 120V, Lithonia #LBL4 LP835 or approved equal. Exit light shal be LED, thermoplastic housing and faceplate, NiCad battery, 120V, Surelite APX6-1-00-R or approved equal.

D. Power Supply: Lighting circuit panel shall be wall mounted and supplied in accordance with Division 16, Electrical. Lighting panel shall be a 42-circuit, 225A bus, 100A main, 120/208V, 3-phase, 4-wire, NEMA 1 panel with integral surge suppression (equal to Square D Surglogic rated 120KA per phase, 60KA line to line and line to ground). Coordinate with Division 16 for all requirements and interface with all devices to be powered through the panel and for the feed from the transformer supplied under Division 16. Circuits to be factory wired through factory supplied conduit and wire shall be for building lighting and receptacles, A/C units (including interface with thermostat), and exit light.

E. Grounding for building and all electrical components shall be supplied and installed under Division 16. Coordinate building fabrication with grounding system requirements.

PART 3 -- EXECUTION

3.01 BUILDING INSTALLATION

A. Factory Assembly: The prefabricated, precast concrete building shall be fully assembled, prewired, pre-plumbed for A/C system, finished and coated at the factory as specified herein. All specified accessories shall be installed by the building manufacturer. The building shall be delivered fully assembled ready for installation on to the prepared elevated slab.

B. Shipping: The building shall be shipped to the jobsite and off loaded and set up at the jobsite by the building manufacturer. Any components and accessories not installed at the factory or broken down for shipping shall be installed in the field by the manufacturer's installation crew.

C. Installation: Building shall be installed at the location and orientation indicated on the Drawings and shall be installed in accordance with approved anchoring systems.

D. Dissimilar Metals: Where the contact or dissimilar metals may cause electrolysis and where aluminum will contact concrete, mortar or plaster, the contact surface of the metals shall be separated using coatings specified in Section 09900. Finished work shall be cleaned and excess coating removed.

3.02 INSTALLATION OF DOORS, FRAMES AND HARDWARE

A. Aluminum Door Frames: Frames shall be installed in correctly prepared openings according to the manufacturer's recommended installation instructions. They shall be set plumb, square and level in correct alignment with floors, ceilings, walls and other work. They shall be securely anchored and completely ready for operation to produce a watertight job. All joints between frames and concrete building shall be tightly caulked with a silicone sealant and neatly pointed. Silicone sealant shall have a color to match the anodized aluminum color. Excess caulking material shall be removed. It shall be the Contractor's responsibility to protect aluminum frame members from damage after installation.

B. Door Installation: Doors shall be installed plumb, level and true to line. Hardware shall be applied and adjusted to achieve quiet and smooth operation. Door clearances shall not exceed 1/8-inch at jambs, heads, and meeting stiles at pairs of doors. Clearance between bottom of door and finished floor material or threshold shall not exceed 1/4-inch. Frames shall be manufactured and machined to within $\pm$ 1/32-inch for all dimensions. The Contractor shall protect door installation from damage after installation.

C. Hardware Installation: Installation of finish hardware shall be per manufacturer's written instructions.

3.03 INSTALLATION OF AC/HEAT UNITS

A. Location and Placing: Locate and place units square, plumb, level and in proper alignment with adjacent work. All work shall be square, plumb, and true, and shall be accurately fitted with tight joints and intersections. All work shall be adequately anchored in place at proper elevations, planes and locations. Use concealed anchorages wherever possible. Anchors into concrete shall be Type 316 stainless steel wedge type anchors. Provide stainless steel washers to protect metal surfaces and to make watertight connections.

B. Joints and Seals: Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers. Exposed work

shall be finished smooth with welds ground smooth. Repair damaged finishes that are approved for field finish repair. Provide new units when field finish repair is not acceptable. Provide concealed gaskets, flashings, sealants and install as the work progresses to make the installations weathertight.

C. Application of Sealants: All joints between unit and concrete shall be filled with a sealant applied under pressure to fill joints completely without air pockets or voids. Tooling shall be performed with a solvent recommended by sealant manufacturer. All joints shall be tooled concave. Sealant shall be a single-component acrylic material meeting Federal Specifications TT-S-230. Sealant shall attain a Shore A hardness of 40-45. Color of sealant shall match louver color as closely as possible.

D. Installation: Install in accordance with manufacturer's instructions. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. All controls and other miscellaneous equipment requiring adjustment shall be adjusted to settings indicated or directed.

3.04 ELECTRICAL WORK

A. All electrical work shall be installed in accordance with the National Electric Code and Division 16 of these specifications. Lighting, receptacles, A/C unit, lighting panel, switches, and associated conduit and wire shall be supplied by the building manufacturer, completely pre-wired and functional. Instrumentation and motor control systems, along with the associated conduit and wire, shall be supplied under Division 16, Electrical.

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SECTION 13500

VIDEO SURVEILLANCE SYSTEM

PART 1 -- GENERAL

1.01 DESCRIPTION

A. Scope of Work: Furnish all materials, equipment and incidentals required to install new video surveillance cameras at the new dewatering structure. The new video cameras shall be suitable for interface, communications, and controls from the County's existing camera controls, video monitors, digital video recorders and signal processor. Provide the necessary video PoE cabling, PoE injectors, media converters, and all related accessories for a complete installation that operates from the County's existing video monitoring displays and controls.

B. Functional Description: The existing system generates video images, processes them, digitally records the images for historical records, and displays real-time images on the system monitors. The system includes capability to remotely control the video cameras for image control of tilt, pan, and zoom. New cameras shall allow this remote control capability.

1.02 QUALITY ASSURANCE

A. Manufacturer: Cameras shall be as manufactured by Hikvision of City of Industry, California (909)895-0400 to match existing equipment used by the County.

B. Installer Qualifications: Installer shall be a factory-authorized and trained service representative to supervise the camera installation and bring all components up to full and complete operation as intended.

C. Comply with NFPA 70, "National Electrical Code" (NEC).

D. Comply with FCC Part 15, "Rules and Regulations, Radio Frequency Drives".

E. NRTL Listing: Provide listed and labeled system components for which there is a listing and labeling service as defined in the NEC, Article 100. Listing and labeling agency shall be a "nationally recognized testing laboratory" as defined in OSHA Regulation 1910.7.

1.03 SUBMITTALS

A. Materials and Shop Drawings: Submit the number of copies and format specified under Division 1 and the Conditions of the Contract for submittals. Submit information on features, components, ratings, and performance criteria for all items supplied with the system. Include dimensional and elevation views of components and detailed wiring diagrams of the system components to completely described the

required wiring interface between components. Show minimum access clearance for all components. Include mounting methods and components.

B. O&M Materials: Submit the number of copies and format specified under Division 1 and the Condition of the Contract for operation and maintenance manuals. Information shall include detailed operating instructions, routine maintenance requirements, list of recommended spare parts and replacement components, as-built system wiring interface diagrams, applicable system certification, information included in the final approved shop drawings, and a copy of the field test reports used to place the system in operation.

C. Non-Conformance Notification: In the event that it is impossible to conform to certain details of the specifications due to different manufacturing techniques, describe all non-conforming aspects.

1.04 DELIVERY, STORAGE AND HANDLING

A. Delivery: Materials and components are to be stored by the manufacturer at their facility until the system is ready for installation to minimize storage requirements at the project site.

B. Storage and Handling: All equipment shall be properly protected from damage until installation is completed and the units and equipment are ready for operation. Each box or package of loose material shall be properly marked to show its net weight in addition to its contents.

1.05 WARRANTY AND GUARANTEES

A. The system supplied under this section shall be warranted for a period of two years by the manufacturer or system supplier. Warranty period shall commence on Owner acceptance as outlined in the General Requirements. The materials and equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the materials and equipment should fail during the warranty period, it shall be replaced and the system restored to service at no additional expense to the Owner.

1.06 SPARE PARTS

A. Provide one set of spare parts as recommended by the system supplier in securely packaged and labeled boxes. As a minimum provide:

1. Minimum of one (1) or 10% of spare fuses for each type and size supplied

2. One (1) spare camera for each type supplied

3. Minimum of one (1) or 10% of spare lenses for each type supplied

PART 2 -- PRODUCTS

2.01 GENERAL

A. Power: Devices shall operate on power-over-Ethernet through the video cabling from a power source with the Centrifuge Control Panel. Coordinate with Centrifuge panel manufacturer for power requirements of the devices supplied.

B. Surge Protection: Protect video signal cabling (both ends) from transient voltage surges utilizing integral surge suppression devices complying with UL Standard 1449, “Surge Suppressions, Transient Voltage”.

C. Environmental Conditions: Outdoor cameras shall be housed in enclosures that prevent penetration of moisture in the event of driven rain. Outdoor components shall be rated for continuous operation in temperature ranges from 0 to 50 degrees C, relative humidity up to 100%. Indoor components shall be installed within the climate controlled environment of the electrical room.

2.02 SYSTEM COMPONENTS

A. Cameras – Hikvision’s DS-2DF8225IH-AELW DarkfighterX Network Speed Dome Camera with the following features:
1. 2 x 1/2.8" Progressive Scan CMOS
2. Up to 1920 x 1080 Resolution
3. Ultra-Low Light:
   Color: 0.001 Lux @ (F1.5, AGC ON)
   B/W: 0.0001 Lux @ (F1.5, AGC ON)
   0 Lux with IR
4. Up to 655 ft IR Distance
5. H.265+/H.265 Video Compression
6. 25x Optical Zoom, 16x Digital Zoom
7. Electronic Image Stabilization
8. Smart Detection: Line Cross, Intrusion, Region Enter/Exit
9. Improved Auto Tracking
10. Rapid Focus
11. Digital WDR, 3D DNR, HLC, BLC
12. IP66 Protection
13. Hi-PoE (maximum 50 W)
14. Pan: 360° endless, configurable speed from 0.1°/s to 210°/s
15. Tilt: From -20° to 90°, configurable speed from 0.1°/s to 150°/s
16. Zoom: proportional, automatic

B. Supports: provide suitable Type 316 stainless steel, aluminum, or fiberglass supports to securely and rigidly fasten cameras in the intended location.

C. Camera Power Supply and Media Converters: Provide PoE injectors integral with the cameras or as separate devices. Provide Stride SE-MC2U-ST unmanaged Ethernet media converters to convert the video image and camera controls from Ethernet to fiber optic communications. House these components with the Centrifuge Control

Panel. Contractor to coordinate with the centrifuge manufacturer for installation of these devices in space left for them. Fiber optic communications shall be by the Centrifuge control panel supplier.

D. Video/Power Cable: CAT6 cable, suitable for below ground conduit installation, of sufficient length to connect to each camera along with all necessary RJ45 and BNC connectors, ties, and fasteners. Cable suitable for both video transmission and power for cameras.

PART 3 -- EXECUTION

3.01 GENERAL INSTALLATION

A. Outdoor Installation: Provide two cameras, located on either end of the truck bed mounted to the overhead catwalk or as otherwise needed. Mount cameras in a manner to provide full video coverage of the entire truck bed internal contents and truck loading conveyor operation. Follow manufacturer's recommendations and install in compliance with all applicable codes.

B. Surge Suppressor Installation: All devices are to be fully protected from electrical surge damage at both ends of video/power cable and in-coming power supply.

C. Cabling Installation: Install cables within conduit raceways installed by the electrical subcontractor. Coordinate size of conduit(s) to be suitable for cable supplied. Do not exceed manufacturer's recommended pulling tensions and do not install cable that has been bruised, kinked, scored, deformed, or abraded. Do not splice cable between camera locations and base.

D. Equalization of Video Signals: Install video distribution amplifiers and attenuators as required to provide consistent, high-level resolution and clarity performance.

E. Cabling Labels and Terminations: Provide permanent, heat-shrink labels for all cables on both ends for all cabling, interior and exterior runs, including interconnect cabling between base components. Terminate wiring on numbered terminals and include all wire and terminal numbers on system as-built drawings.

3.02 TESTING AND FIELD SERVICES

A. Manufacturer's Field Services: Provide services of factory-authorized service representatives to conduct the field assembly and connection of components and system testing and adjustment. Service representative shall align, calibrate, label, and adjust all components to conform to system requirements.

B. Inspection: After installation and prior to testing, service representative shall provide a written statement verifying that all components have been properly installed and are ready for powering and testing.

C. Initial System Tests: Service representative shall place the system in operation and fully test all functions of the system to verify proper installation and setup. Service representative shall then provide notification to the County that the system is ready for demonstration and training of County personnel on use of the system.

3.03 CLEANING

A. Clean all system components, including camera housing windows, lenses, and monitor screens, as part of the initial tests, using methods and materials of the type and extent recommended by the component manufacturer(s).

3.04 ADJUSTMENTS

A. Within the first year after the beginning of the warrantee period, provide on-site assistance in adjusting the system or follow-up training to suit actual operational conditions for up to two (2) separate visits to the site as requested by the County.

3.05 TRAINING

A. The service representative shall provide complete training on the operation, adjustment, and maintenance of the system to County personnel. Training shall be given on-site with the system in operation after checkout and initial testing. Training shall be for a minimum of four (4) hours for each of two (2) separate training sessions to allow for training of individuals on separate shifts.

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DIVISION 14

Conveying Systems

SECTION 14554

SCREW CONVEYORS

PART 1 -- GENERAL

1.01 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified and required to furnish, install, test, and startup the screw conveyor equipment. Included are conveyor supports, drives, field instruments, chutes, chute slide gates and actuators, and all appurtenances.

2. Screw conveyors will be used for transporting mechanically dewatered sludge.

3. CONTRACTOR shall install the following:

a. One new horizontal, shaftless screw conveyor

4. CONTRACTOR shall be responsible to coordinate the transition pieces from the centrifuge to the new horizontal screw conveyor. All such transition pieces shall result in closed units to avoid odor emissions and spillage of material at any point.

B. Coordination:

1. The Drawings show outline of the various pieces of equipment and their overall relationships. CONTRACTOR shall provide drawings showing details, interfacing and installation of equipment with all necessary appurtenances.

2. CONTRACTOR shall coordinate the design, installation and the interfacing of the conveyors with associated equipment. CONTRACTOR shall meet with the conveyor and equipment manufacturers to review the interfacing, installing, and requirements of the equipment to ensure a compatible, entirely satisfactory system of materials handling.

C. Related Work Specified Elsewhere:

1. Section 01660, Equipment Testing and Training.

2. Section 03300, Cast-in-Place Concrete.

3. Section 03315, Grout.

4. Section 05120, Structural Steel.

5. Section 05500, Metal Fabrications.

6. Section 09900, Painting.

7. Division 16, Electrical.

8. Division 17, Sections on Instrumentation and Control.

1.02 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer shall provide evidence of at least fifteen (15) years demonstrable experience in the design and manufacture of shaftless conveyor systems. The Supplier shall have at least twenty (20) full-scale shaftless conveyor systems operating successfully for at least five (5) years in North America at municipal wastewater treatment plants that were designed and furnished under the Supplier's own name. Equipment bought and re-sold; or supplied under a license or marketing agreement shall not be considered for meeting the experience clause.

B. Source Quality Control: The screw conveyor system shall be the product of one manufacturer who shall be solely responsible for the operation of the equipment in conformance with this specification. The manufacturer shall provide a complete and operable system for the equipment specified and shall be responsible for the design, inspection, and operation of the equipment furnished.

C. Fabricate and assemble all equipment under this section in full conformity with this specification and as shown in the contract drawings.

D. Furnish equipment complete with all supports; all mechanical equipment required for proper operation, including complete drive units; all steel and other metal construction specified herein; and all additional materials or fabrication as required by the supplier's design.

E. Unless otherwise noted:

1. All equipment included in this section shall be furnished by a single supplier who shall be responsible for the design, coordination, and the satisfactory operation of the system.

2. Spirals furnished with the shaftless conveyor(s) shall be produced from spiral manufacturing equipment owned by the conveyor supplier or supply partner located in North America.

F. Reference Standards: Comply with the applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. American Bearing Manufacturers Associations (ABMA).

2. American Gear Manufacturers Association (AGMA).

3. American Institute of Steel Construction (AISC).

4. American Iron and Steel Institute (AISI).
5. American National Standards Institute (ANSI).
6. American Society for Testing and Materials (ASTM).
7. American Welding Society (AWS).
8. Conveyor Equipment Manufacturers of America (CEMA).
9. Institute of Electrical and Electronic Engineers (IEEE).
10. The Instrumentation, Systems, and Automation Society (ISA).
11. National Electrical Code (NEC).
12. National Electrical Manufacturers Association (NEMA).
13. Occupational Safety and Health Administration (OSHA).

1.03 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Manufacturer's literature, illustrations, specifications and engineering data including: materials, dimensions, weights, performance data, brake horsepower, motor horsepower, and operational safety devices.
2. Fabrication, assembly and installation drawings showing interfacing with equipment served, wiring diagrams, interlocks, and locations of utilities.
3. Setting drawings, templates and directions for installing anchorages.
4. Design drawings and calculations of the screw conveyor collection and discharge chutes.
5. Design drawings and calculations of the conveyor structural support system and the weights and load reactions to be carried at each support. A registered Professional Engineer in the State of Florida shall design and sign/seal the structural support drawings and calculations.
6. Catalog cut sheets and dimensional drawings for the discharge slide gates along with orientation drawings for the gates and actuators related to the conveyor and conveyor access cat walk.

B. Operation and Maintenance Manuals: Submit for approval operation and maintenance data in a form that complies with Specification 01660. Submittals shall be in accordance with the procedures and requirements set forth in Section 01300 entitled “Submittals”. Two copies of the preliminary O&M manual shall be included in the shop drawing

submittal. Without inclusion of these manuals, the submittal will be considered incomplete and will be returned without review.

Complete manuals shall include:

1. Startup procedures, routine maintenance schedules, screw repair, and replacement and spare parts information.

2. List of required maintenance materials including: lubrication oils, greases, seals, packings, gaskets, paint, bearings, and other wear items.

3. Trouble diagnostic data including detection and the required corrective measures with detailed procedures.

4. A copy of all approved shop drawings.

C. Quality Control Submittals

1. Manufacturer's Certificate of Compliance, including performance guarantee and materials certifications used on all components of conveyor (trough, supports, drive shafts, spirals, etc.).

2. Special shipping, storage, protection, and handling instructions.

3. Manufacturer's installation instructions.

4. Manufacturer's letter of proper installation.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the site to ensure uninterrupted progress of the Work.

B. Ship each screw conveyor frame as a complete unit or in sections as long as possible.

C. Clearly identify contents of all boxes, crates, or packages.

D. All boxes, crates and packages shall be inspected by the CONTRACTOR upon delivery to the site. CONTRACTOR shall notify the ENGINEER if damage exists to any equipment or components.

E. Store materials to permit easy access for inspection and identification. Store mechanical and electrical equipment in interior dehumidified storage. Ferrous surfaces shall not be stored in contact with ground.

1.05 WARRANTY

A. In addition to the requirements of the General Conditions and the Special Conditions, the CONTRACTOR shall require the manufacturer to furnish a warranty valid through the warranty period to assure that any equipment specified herein which does not meet

the performance requirements for the specifications, is repaired to the COUNTY's satisfaction or replaced with equipment that does meet the performance requirements of the specification. The warranty shall be for minimum period of two years from the date of Beneficial Occupancy for the portion of work associated with the equipment specified herein.

1. Liner: Excessive wear shall be indicated if the thickness of the liner, at three points over a 30 percent long section of the conveyor, is ¼-inch thick or less at the thinnest point of the liner, during the first two years of service. The conveyor manufacturer shall supply a two color liner that indicates to the owner that a minimum of ¼-inch of liner is remaining. If excessive liner wear is found the conveyor supplier shall provide new formed liners stored in metal racks to hold the shape of the liner to replace all the liner in the conveyor that has excessive wear.

2. Screw: Excessive wear on the screw shall be indicated by loss of more than 50 percent of the height of the main outer screw section over 30 percent of the total length of the screw. If excessive screw wear is found, the conveyor supplier shall provide a new screw to replace the screw in the conveyor that has excessive wear.

PART 2 -- PRODUCTS

2.01 HORIZONTAL, SHAFTLESS SCREW CONVEYOR

A. Description: Provide shaftless screw conveyor without intermediate bearings or tail end bearings to convey mechanically dewatered waste activated sludge in a totally enclosed and lined trough.

B. Service Conditions

1. The screw conveyor shall be specially designed, constructed, and installed for transporting mechanically dewatered sludge and shall comply with the following minimum requirements.

Number of Units Installed	One (1)
Types	Horizontal Shaftless Screw
Vendors	Spirac, Custom Conveyor, JMS, Atara
Screw Diameter, inches (minimum)	12
Trough Diameter, inches	13, CEMA
Nominal Screw Length	27.5
Maximum Trough Length	28.5
Material Transported	Dewatered Sludge Cake
Mass Loading Capacity, lbs(dry)/hour	2,400
Mass Loading Capacity, pounds (wet)/hour	13,600
Volumetric Capacity, cubic feet/hour	300
Inlet	1
Outlets	5, (4 with slide gates)

Motor hp	5
Rotating Speed, rpm	<25
Electrical Power Feed	460 VAC/ 3-PH / 60HZ
Motor Control Capability	Mono-Directional
Slope/inclination	Horizontal
Screw Pitch	Full (12” Minimum)
Number of Pressure Relief Covers	TBD by manufacturer

6. Design Capacity: The screw conveyors furnished shall be designed to operate continuously at the specified operating conditions. Size each conveyor to convey their design-rated capacity.

C. Details of Construction

1. Manufacturer: Provide equipment as manufactured by one of the following:

   a. Spirac.

   b. Custom Conveyor.

   c. JMS (Jim Myers and Sons, Inc.)

   d. Atara.

   e. Engineer approved equal.

2. General:

   a. Conveying equipment shall be suitable for continuous operation without excessive wear.

   b. There shall be no projecting set screws or other parts or sharp or protruding edges.

   c. All devices required for the compliance with safety laws shall be provided.

   d. Corresponding parts of multiple units shall be interchangeable.

3. Screw Conveyors:

   a. The conveyor drive units shall be designed for 100 percent of rated capacity and shall be capable of starting the conveyors with a completely full trough.

   b. Conveyors shall be designed without a center shaft for conveying material with minimal maintenance. Spiral flights shall be designed to be self guiding and aligning in the trough. Guide bearings shall not be permitted.

   c. Prior to fabricating the screw conveyors, determine the requirements for and

furnish brackets, chutes, and all hardware required for a complete system.

d. Conveyor Materials:

1) Steel Plate and Shapes: Type 316 stainless steel.

2) Inlet and Outlet Chutes: Locations as shown, ASTM A 167, 3/16-inch thick Type 316 stainless steel. Dimensions and shape to be determined by manufacturer to meet requirements of the connecting equipment.

3) Spiral Flights: Cold-formed spring steel, minimum hardness 250 Brinell with ability to transmit a minimum of 32,000 inch-pounds of input torque. Manufacturer to supply material data sheet including brand name steel and Brinell hardness.

4) Drive Shaft: Heat-treated alloy steel AISI, Grade 4150, of uniform diameter.

5) Wear Liner: 1/2-inch minimum thickness UHMW polyethylene. Attached to the trough with Type 316L stainless steel cleats, 3/8-inch minimum thickness installed as required by manufacturer. Liners shall be sintered with an antiwear filler to reduce wear and a synthetic lubricant to reduce friction. Wear liner bars are not acceptable.

6) Fasteners for Conveyor Supports: ASTM A 193/A 193M, Type 304 stainless steel.

e. Conveyor Troughs:

1) Fabricated from 3/16-inch minimum, ASTM A l67, Type 316L stainless steel.

2) Troughs shall conform to the dimensional standards of CEMA 300-34 and enclosure Classification II E.

3) Troughs shall be U-shaped, double rolled down flange style.

4) Trough end plates shall be 3/8-inch thick, type 304 stainless steel and shaped to support bearings and drives in true alignment.

5) Screw conveyors shall have trough end plates with a foot to support conveyor weight.

f. Spiral Flightings:

1) Design spiral flights with the stability to prevent distortion and jumping in the trough. Flight thickness shall be a minimum of 3/4-inch.

2) At its torsional rating, the stress in the spiral flightings shall not exceed 30 percent of the Fy value in the extreme fiber of the flight material.

3) Brake Horsepower: Produce less torque than the spiral flighting is rated for.

4) At 250 percent torque of the motor nameplate horsepower rating, the drive trains shall not produce more torque than the spiral flightings' torsional ratings.

5) The spiral edges shall be smooth in the as-rolled condition and not show grinding marks.

6) The "spring effect" of the spirals shall not exceed 0.8 percent of total spiral lengths.

7) Pitch of all flights shall be constant over entire length of screw conveyor.

g. Conveyor Bearings: Bearings shall be integral with the gear drive (no external bearings), shall be high capacity roller bearings with an L-10 life rating of 100,000 hours, and designed to support thrust loads and provide angular alignment with the trough.

h. Conveyor Drive Shaft Seals: Compression packing gland between the drive shafts and sleeves.

i. Conveyor Covers:

1) The cover sections are to be attached to the trough flange hinges with stainless steel bolts, washers, lock washers and nuts and supplied with quick release clasps on the non-hinged side for easy access to interior of trough.

2) Minimum 12-gauge, ASTM A 167, Type 304 stainless steel.

3) Gaskets between trough and cover as specified in this section.

4) Conform to Screw Conveyor Standards CEMA 300.

j. Gear Reducing Drive Motors:

1) Design for full thrust loads from spiral flights.

2) Bearings: L-10 Operating life of 100,000 hours.

3) AGMA, Class II, reduction helical gears.

4) Air cooled, no auxiliary cooling allowed.

5) Close coupled with drive motors.

6) Applied Torque: Adequate to start the screw conveyors when fully loaded.

7) Flange mounted to conveyor end plates.

8) Rigidly supported.

9) TEFC Type II motor enclosures.

10) 480 volt, 3-phase, 60 Hz.

k. Conveyor Supports:

1) Minimum 1/4-inch thickness, rectangular, Type 304 stainless steel shapes and plates.

2) Ratio of unbraced length to least radius of gyration shall not exceed 240 for tensile members and 120 for compression members.

3) Designed to not exceed 1/3 of AISC allowable stresses when loaded to twice the running torque of the motor.

4) Support Loads shall be based on completely filled trough, weight of the conveyor, and dynamic loading when operating.

5) Coordinate support locations with existing and new facility structure. Supports shall not restrict access to other process systems.

6) Hanging supports shall be furnished 6” longer than required for field fit & trim by the Contractor. Contractor shall supply and use Engineer approved hanger systems.

i. Gaskets: Provide neoprene, 50 durometer, 1/8-inch thick gaskets to be located at face for entire top of trough flange and at flanged fittings with drop chutes.

j. Discharge Chute Slide Gates: The first four discharge chutes shall be provided with truck loading slide gates with 120V electric actuators to allow diversion of cake down to separate sections of the truck bed for even loading of the material. The last chute in line shall not require a slide gate (if all four gates on the other chutes are closed, the material will pass through to the last chute). Truck loading slide gates shall be supplied with the conveyor under this Section and shall meet all the requirements of Section 15207, including mounting requirements and electric actuators.

D. Fabrication

1. The equipment manufacturer's shop welds, welding procedures, welders and welding operators shall be qualified and certified in accordance with the requirements of AWS D1.1/D1.1M.

2. Fabricate all parts and assemblies from sheets and plates of Type 304 stainless

steel sheet with a 2D finish conforming to AISI Type 304 and ASTM A 666, unless noted otherwise. Fabricate all tubular products and fittings to conform to ASTM A 269, ASTM A 351/A 351M and ASTM A 403/A 403M.

3. All welding in the factory shall be performed using the shielded arc, inert gas, MIG or TIG method. Add filler wire to all welds to provide for a cross section and weld metal equal to or greater than the parent metal. Fully penetrate butt welds to the interior surface and provide gas shielding to interior and exterior of the joint.

4. Field welding of stainless steel will not be permitted except where shown in the drawings.

5. Bolts, nuts and washers shall be AISI Type 316L stainless steel furnished in accordance with ASTM A 193/A 193M and ASTM A 194/A 194M.

6. Passivate all stainless steel surfaces by using the following procedure:

    a. Wire brush all weld areas to remove weld spatter. Brushes shall be Type 304 stainless steel and used only on Type 304 stainless steel.

    b. Bead or pumice blast all external non-wetted stainless steel to a uniform finish.

    c. In lieu of bead or pumice blasting, weld passivation may be used.

E. Accessories

1. Motion Switches:

    a. Provide non-contacting, proximity-type speed switch for detecting zero speed condition on monitored equipment consisting of a sensor/pre-amplifier and an amplifier/output switch unit.

    b. The sensor/pre-amplifier shall utilize magnetic proximity effect to detect equipment rotational speed without physical connection to the rotating equipment. Sensors shall provide output pulses in proportion to rotational speed by detection of a ferrous target mounted on the rotating equipment. The sensor shall operate satisfactorily with air gaps of up to 4 inches. Provide sensor/pre-amplifier complete with mounting flange, threaded body and locknut.

    c. The amplifier/output switch unit shall provide two single-pole, double-throw contacts that operate on underspeed detection. Provide dry contact outputs rated for 5 amps at 120 volts AC. The unit shall include an adjustable start-up delay of 0 to 60 seconds to override zero speed alarm during initial acceleration. Units shall operate on 120 volt AC power. Provide set point adjustment range of 2 to 3,000 pulses per minute. Zero speed switch shall be Milltronics MFA-4 with MSP-12 sensor/pre-amplifier.

    d. All motion switches shall have NEMA 4X enclosures.

2. Pull-Cord Stop Switch: Provide conveyor with nylon "Pull-Cord" on both sides in ring supports, with indicating (flag) type stop switches mounted near motor.

3. Level Transmitter Mounting: Provide mounting mechanisms suitable for mounting of the ultrasonic level transducers supplied under Division 17. Location of level sensors shall be such that each sensor monitors the level in the truck bed, centered on the truck bed which is offset from the center of the conveyor as noted on the Drawings. Level sensor mounting shall also be such that the ultrasonic wave cone is not interfered with by the cake droppings from the associated or adjacent chutes. Mounting components shall be of the same material as the conveyor trough and all mounting hardware shall be Type 316 stainless steel. Coordinate mounting requirements with approved shop drawings for the level sensors.

F. Factory-Applied Protective Coatings

1. Exterior Surface Preparation and Protective Coatings:

a. All non-stainless steel surfaces shall be factory primed and finish coated in accordance with Manufacturer's recommendations and the requirements of Section 09900, Painting.

b. Manufacturer shall provide touch-up paint as required for field application following installation.

2. Stainless Steel Surfaces: Glassblast, or weld passivate all exterior stainless steel surfaces only to a uniform finish.

3. Gearboxes, motors, bearings, etc. are to be supplied in manufacturer's standard enamel finish.

G. Tools, Spare Parts, and Maintenance Materials

1. Spare Parts

a. One (1) set of packing material for each stuffing box.

2. Supply a complete set of any specialty maintenance tools required to replace and repair the conveyors.

3. Furnish an initial supply of all greases and lubricants required.

4. Maintenance repair kit for conveyors and repairable wear items as recommended by the equipment manufacturer.

5. Tools, spare parts, and maintenance materials shall be packed in sturdy containers with clear indelible markings, identifying parts, and the equipment for which intended. All shall be stored in a dry, warm location. When project has achieved

Beneficial Occupancy, CONTRACTOR shall inventory and place parts in a location designated by the OWNER.

H. Factory Assembly and Testing

1. Completely shop assemble the screw conveyors with drive motor prior to shipment and run under no load for a minimum of 15 minutes to ensure proper operation. Provide a signed shop test certificate and record amperage on the motors.

2. Inspect equipment and test for proper alignment, quiet operation, proper connection and satisfactory performance of components. Match-mark any sections which have to be disassembled for the purposes of shipping.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Installation shall be in accordance with the approved shop drawings and with manufacturer's instructions.

B. All equipment assemblies shall be installed on concrete bases and secured with anchor bolts. The concrete bases shall be poured up to 1 inch below the metal bases, or legs. Concrete and grout work shall comply with applicable requirements of Division 3.

C. Provide piping and coordinate equipment drains with floor drains.

D. Coordinate with piping for equipment flushing and drain.

E. Apply initial lubricants as recommended by the equipment manufacturer.

F. Coordinate and interface conveyor installation with equipment served; resolve interferences.

G. All equipment shall be aligned to the best industrial standards. Check and adjust all alignment in the field in the presence of the ENGINEER.

3.02 START-UP AND TEST

A. CONTRACTOR shall verify that structures, equipment, shaft, motor, and drives are compatible for an efficient system.

B. CONTRACTOR shall make adjustments required to place conveyor systems in proper operating conditions.

C. The conveyor equipment manufacturer's representative shall check and approve the installation before operation. The representative shall instruct plant personnel on care and maintenance of the equipment. The representative shall revisit the job site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.

3.03 MANUFACTURER'S SERVICES

A. CONTRACTOR shall furnish the services of a qualified factory-trained serviceman who shall assist in the installation of the equipment, check the installation before it is placed into operation, supervise testing, supervise initial operations, and instruct the plant operators in the care, operation and maintenance of the equipment.

3.04 TRAINING

A. In addition to the above requirements, furnish service of a qualified factory trained operations and maintenance serviceman to instruct and train operators and maintenance staff in the proper care, operation and maintenance of the equipment. At least two separate visits to site shall be scheduled. Each visit shall be for a minimum of one 8-hour day, excluding travel, for each conveyor.

3.05 MANUFACTURER'S REPAIR SERVICES

A. Guarantee: In addition to the manufacturer's standard guarantee, include the services of a factory-trained serviceman to provide repair service for the equipment during the specified warranty period. This service shall include the cost of replacement parts required during the interval.

B. Replacement parts or equipment installed during the specified warranty period shall be equal to or better than the original.

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SECTION 14620

TRAVELING BRIDGE CRANE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, and place in satisfactory operation the hoisting equipment and appurtenances complete with all necessary safety equipment in accordance with the requirements of the Contract Documents. Location, capacity, critical dimensions, and other pertinent data shall be as specified.

B. The Contractor shall furnish, materials, equipments and all incidentals required to install and test, complete, and ready for operation an electrically operated traveling bridge crane including electric hoist, runway beams, ASCE rails, end trucks, drives, traveling trolleys, and pallet fork, as shown on the Contract Drawings and as specified. Minimum lift clearances for equipment located below the crane shall be provided and coordinated with equipment suppliers. All materials shall be new and both workmanship and materials shall be of the very best quality, entirely suitable for the service to which the units are to be subjected and shall conform to all applicable sections of these specifications.

C. This Section consists of rails, beams, electric hoists, trolleys, end trucks, and accessories as required for a complete installation as shown on the Drawings and specified herein. The Contractor shall furnish and install the crane rails, ancillary steel, and appurtenances necessary for all hoists.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01420 - Submittals

B. Section 11000 - Equipment General Provisions.

C. Section 16010 - Electrical General Provisions

D. Section 16150 - Electric Motors

1.03 REFERENCE SPECIFICATIONS CODES, AND STANDARDS

A. Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to or exceed the applicable requirements of the referenced documents to the extent that the requirements therein are not in conflict with the provisions of this Section.

1. Codes:

a. ANSI/NFPA National Electrical Code.

b. Latest edition of the Florida Building Code.

2. Government Standards:

   a. OSHA (Occupational Safety and Health Administration Standards.)

3. Commercial Standards:

   a. AISC (Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings.)

   b. AGMS Standards (American Gear Manufacturers Association.)

   c. ANSI B30.11-1980, Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoists).

   d. ANSI B30.16-1981, Portal, Tower, and Pillar Cranes.

   e. ASTM A36, Specification for Structural Steel.

   f. NMA, Specifications for Under Hung Crane.

   g. NEMA Standards (National Electrical Manufacturers Association.)

   h. Crane Manufacturer's Association of America (CMAA) Specification No. 74-1994 Specifications for Top Running and Under Running Single Girder Electric Traveling Cranes Utilizing Under Running Trolley Hoist.

1.04 SUBMITTALS

A. The Contractor shall submit complete Shop Drawings of all hoist and crane equipment in accordance with the requirements of the Section "Submittals". Such shop drawings shall include all electrical requirements, weights, wheel loads, dimensions, and clearances required. The design of the girders used for the bridge crane shall be the responsibility of the crane supplier. The Shop Drawings shall include calculations and design data signed and sealed by a Professional Engineer registered in the United States.

B. The Contractor shall furnish to the Engineer copies of complete operating and maintenance instructions of all the hoist and crane systems as specified under Section "Submittals". The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, description, etc. that are required to instruct operation and maintenance personnel unfamiliar with such equipment.

1.05 ACCEPTABLE MANUFACTURERS

A. The equipment covered by these Specifications are intended to be standard equipment of proven reliability and as manufactured by reputable manufacturers having experience in the production of such equipment. Manufacturer shall be Advanced Overhead Systems, or Engineer approved equal.

1.06 MANUFACTURER'S EXPERIENCE

A. System shall be supplied through an experienced vendor, regularly involved in the supply and installation of hoist and crane systems. Contractor shall employ a qualified vendor such as Advanced Overhead Systems, or Engineer approved equal. Each component and ancillary equipment item furnished under this specification shall be new and unused, of the type, size, design, and efficiency installed on previous similar projects and the product of manufacturers having a successful record of operation, manufacturing and servicing the equipment for a minimum of five years prior to bid date. Suppliers shall supply Engineer with previous installation details and references on at least three successful operations of a similar nature within a period of last two years.

1.07 SERVICE OF SUPPLIER'S REPRESENTATIVE

A. The Contractor shall have the equipment supplier provide the services of a trained, qualified representative for at least one day after the units are put in proper working order, or as otherwise specified, for the purpose of inspecting the installation and instructing the Owner's operating personnel.

B. All fabrication, assembly, and welding shall be carried out by factory-trained specialists and certified welders.

1.08 QUALITY ASSURANCE

A. Inspection and Testing Requirements: After erection, the Contractor shall inspect and load test all hoists and crane systems in the presence of the manufacturer's representative, for proper operation and conformance with the Specification.

B. Acceptance Criteria and Tolerances: The Engineer reserves the right to reject any equipment not conforming to the tolerances, deflections, and lateral stiffness specified.

1.09 CLEANUP

A. After completion and testing the Contractor shall remove all debris from the site, repair any damage to the structure and site, and clean all his work and equipment to put it in proper working condition.

1.10 GUARANTEES, WARRANTIES

A. The Contractor shall provide any guarantees and warranties in accordance with Section 11000 entitled "Equipment General Provisions".

B. The manufacturer shall warrant all parts, free from defective material and workmanship for a period of two years after substantial completion, and furnish and install for the Owner any such items found to be defective within the two-year period.

1.11 PRODUCT DELIVERY, STORAGE AND HANDLING

A. The Contractor shall be responsible for the delivery, storage and handling of the equipment as specified in Section 11000 entitled "Equipment General Provisions".

B. Special care shall be exercised during delivery, handling, and storage of equipment and material to prevent damage, degradation of materials, and fouling.

C. All parts shall be shipped to the job site adequately palletized and protected from breakage and dirt.

1.12 TOOL, SUPPLIES AND SPARE PARTS

A. The Contractor shall supply one complete set of special wrenches or other special tools necessary for the assembly, adjustment, and dismantling of the equipment. All tools shall be of best quality and furnished in labeled tool boxes of suitable design.

1. Certified shop and erection drawings showing all important details of construction, dimensions and anchor bolt locations.

2. Descriptive literature, bulletins, and/or catalogs of the equipment.

3. The total weight of the equipment including the weight of the single largest item.

4. A complete total bill of materials of all equipment.

5. A list of manufacturer's recommended spare parts to be supplied in addition to those specified herein with the manufacturer's current price for each item.

6. Complete motor and gear reducer data.

7. Maximum wheel load and spacing for verification of crane runway girder design.

B. Each piece of equipment shall be furnished with one year's supply of spare parts as recommended by the manufacturer, such as lubricants, bearings, drive belts, seals, washers, rings, and any other parts subject to wear or frequent replacement. All parts shall be properly labeled and identified with the name and number of the equipment to which they belong.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Quality: Materials shall be new and workmanship and materials shall be of the very best quality, entirely suitable for the services they are to perform. Structural steel shall conform to ASTM A 992, except when otherwise specified. Iron castings shall be of tough, closegrained gray iron, free from blow holes, flaws or excessive shrinkage and shall conform to ASTM A 48.

B. Safety: Traveling bridge equipment shall be designed with a safety factor based on the ultimate strength of the material of not less than five. All parts of the mechanisms furnished shall be amply designed and constructed for the maximum stresses occurring during fabrication, erection and continuous operation.

C. Flexibility of Replacements: Corresponding parts of the equipment shall be interchangeable and all parts subject to wear shall be of standard pattern easily replaceable without the necessity of special cutting and fitting.

D. The capacity, traveling speed and other pertinent data related to the hoists and trolleys shall be as follows:

Vendor	Advanced Overhead Systems
Load	7.5 tons
Span	42 ft*
Lifting Height	40 ft - 3 in*
Hoisting Speed	20.0/3.2 ft/min, variable speed
Traversing Speed	65 ft/min, variable speed by inverter
Traveling Speed	100 ft/min, variable speed by inverter
Main/Control Voltage	460/115 V / 60HZ
Supply Power	17 Hp

**The Contractor shall coordinate final dimensions of the pre-engineered building and bridge crane with both manufacturers.*

2.02 MOTOR OPERATED HOIST

A. The hoist unit shall include a directly coupled motor, dc disk brake, gear train, hook, pallet fork, drum and electrical controls. Rated capacity shall be stamped on the hoist frame. The frame shall be of steel construction, with no part of the load carried by assembly bolts. Gears shall be machine cut, heat treated and grease lubricated. Except for the drum pinion, no gears shall be cantilever mounted. Shafting shall be ground and polished, and all bearings shall be of the antifriction type. Grease fittings and oil reservoir shall be readily accessible. The load block shall be of the safety type with guarded sheaves and forged swivel hooks. Hooks shall open slowly when subjected to heavy overloads. Pallet fork shall be as manufactured by Caldwell Model 90ACL-2, or Engineer approved equal. The dc disk brake shall be spring set with magnetic release operated by and interlocked with the electrical control equipment. Stressed parts shall be of cast or forged steel. In the event of a power failure, the braking system shall automatically lock the place of equipment being lifted to prevent further movement.

2.03 MOTOR OPERATED TROLLEY

A. The motor driven trolley shall include a two-speed, 460 volt, 3 phase gear motor. All load carrying parts shall be of steel. The wheels shall have hardened treads. Wheels and axles shall be equipped with antifriction bearings, permanently sealed and lubricated.

2.04 MOTOR OPERATED TRAVELING BRIDGE

A. The traveling bridge shall be of the top running single girder type. The bridge beam shall consist of structural steel of proper size to hold the rated load, rigidly welded to the end truck assemblies, reinforced with welded gusset plates to maintain ton square-ness with trucks. Under full load the bridge beam deflection shall not exceed L/600 of the span.

B. The end truck frame shall be welded from structural shapes or steel tubes into single unit of sufficient strength as to prevent distortion and mismatch of gears under maximum rated load. End truck wheelbase shall be a minimum of 1/8 of the crane span.

C. The truck shall contain diaphragm members welded to truck frames to maintain alignment and distribute truck loads uniformly on inner and outer truck member. The truck shall be designed so that the drop of the load will be limited to one inch in case of axle or wheel failure. Attachment of end truck to bridge beam shall be by welding to insure true alignment.

D. The traveling bridge shall be a variable speed unit with a hard-wired cable control on the top level and a wireless remote for the lower level.

E. All gears shall be cut from solid blanks with 20 degree pressure angle involute shape for high strength and shall comply with AGMA specifications for load ratings. The gear train shall provide for a minimum service corresponding to five years minimum intermittent industrial use.

F. Crane wheels shall be double-flange alloy steel and have tread surfaces hardened to 260-302 BHA. Tread shall be tapered to provide suitable running alignment for crane. Each wheel shall be supported on ball bearings mounted on rotating axles suitable to take radial and thrust loads. The stationary axles shall be suitable to take radial and thrust loads. The wheels shall be lubricated at the factory with sodium-base grease and provided with a suitable reservoir of lubricant to eliminate the need for field lubrication. Wheel axles must have mounting nuts for bearing adjustment. Wheel mounting shall be designed so that axles and wheels can be removed without disturbing other truck elements of their alignment. Wheel treads shall be smooth, true and uniform within .010-inch tread diameter on all wheels.

G. Bumpers and stops shall be installed on the bridge and runway rails, and shall be as shown on the Drawings. Bumpers and stops shall meet the requirements of CMAA Specification No. 74-1994 and shall be located so that no part of the bridge or trolley extends over the end.

2.05 MOTORS AND ELECTRICAL EQUIPMENT

A. Motors shall be designed for 460 volts, 3-phase, 60-cycle power operation. Electrical equipment and wiring shall comply with the latest NEMA hoist requirements and the requirements specified herein, and in Section 16150 entitled "Electric Motors." Motors shall be TENV squirrel cage induction motors with ball or roller bearings. Motor ratings shall be on a 30 minute, 55 degree Celsius duty cycle basis.

B. Limit switches shall be geared type or upper/lower paddle, positive in action, compact, weatherproof and readily accessible. Brakes shall be DC disc brakes spring set with magnetic release.

C. An flat cable festoon system shall be supplied along the bridge support beam capable of carrying a minimum of 30 amperes per pole (continuously), 3 phase, 480 volts. The cable shall be supported as recommended by the manufacturer.

D. Starting equipment shall be integral with the motors and shall be of full voltage, magnetic-reversing combination circuit breaker type starter with three overload elements and under-voltage protection. Equipment shall be housed in NEMA 4 enclosure.

E. Pendant controls (upper level operation) for hoist lift, trolley travel, and bridge travel shall be provided complete with heavy duty pushbotton station of constant pressure type with silver to silver contact elements, and lengths of control cable and chain for support for control station to be readily accessible 4 feet from floor level. Pendant controller shall have 8 control buttons for ON/OFF, UP/DOWN, NORTH/SOUTH (bridge) and EAST/WEST (trolley). Control power shall be 120 volt, provided by a control power transformer within the starter units. One side of this transformer shall be grounded; the other side shall be connected via a fuse.

F. Wireless Remote (lower level and upper level operation) for the system shall provide complete control of the unit with all control features noted for the hard-wired pendent device. Remote device shall be battery operated using standard size, long life batteries, in a waterproof enclosure. Provide a sturdy, corrosion resistant, and lockable enclosure for the remote device to be mounted as directed by the County (outdoor location).

G. Length of wire rope shall be such that a minimum of two full wraps of wire rope will remain on the hoist with the hook at installed pump hook level. Momentary mainline shall be provided to disconnect power from crane. Mainline shall be controlled from the pendant station.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. The equipment shall be erected by the Contractor in accordance with the manufacturer's instructions. The manufacturer shall be responsible for any additional supports required to provide a safe operating hoist system and these supports shall be installed by the Contractor. All equipment and installation practices shall conform to the applicable requirements of OSHA requirements.

3.02 TESTING

A. After installation of equipment, the Contractor shall test each hoist with a load at least 125 % of the rated capacity of each hoist. The test procedure shall be submitted to and approved by the Engineer before any testing is performed.

3.03 PAINTING

A. Track: Track shall be sandblasted in accordance with SSPC-SP10 near White Blast Cleaning in the shop and primed within six hours using the primer as specified in the Section 09900 entitled, "Painting". Finish painting shall also be in accordance with the Section 09850 entitled “Painting”. Rated load markings shall be attached to the equipment in accordance with OSHA requirements.

B. Motors: Motors shall be shipped to the site with manufacturer's prime coat that is compatible with the finish coats specified in the Section 09900 entitled "Painting". After installation and before being placed in final operation, the Contractor shall have motors painted in accordance with the requirements of the Section 09900 entitled “Painting”.

- END OF SECTION -

DIVISION 15

Mechanical

SECTION 15000

BASIC MECHANICAL REQUIREMENTS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install to the required line and grade, all piping together with all fittings and appurtenances, required for a complete installation. All piping located outside the face of structures or building foundations and all piping embedded in concrete within a structure or foundation shall be considered exterior piping.

B. The Contractor shall furnish and install fittings, couplings, connections, sleeves, adapters, harness rods and closure pieces as required to connect pipelines of dissimilar materials and/or sizes herein included under this Section and other concurrent Contracts for a complete installation.

C. The Contractor shall furnish all labor, materials, equipment, tools, and services required for the furnishing, installation and testing of all piping as shown on the Drawings, specified in this Section and required for the Work. Piping shall be furnished and installed of the material, sizes, classes, and at the locations shown on the Drawings and/or designated in this Section. Piping shall include all fittings, adapter pieces, couplings, closure pieces, harnessing rods, hardware, bolts, gaskets, wall sleeves, wall pipes, hangers, supports, and other associated appurtenances for required connections to equipment, valves, or structures for a complete installation.

D. Piping assemblies under 4-inch size shall be generally supported on walls and ceilings, unless otherwise shown on the Drawings or ordered by the Engineer, being kept clear of openings and positioned above "headroom" space. Where practical, such piping shall be run in neat clusters, plumb and level along walls, and parallel to overhead beams.

E. The Contractor shall provide taps on piping where required or shown on the Drawings. Where pipe or fitting wall thicknesses are insufficient to provide the required number of threads, a boss or pipe saddle shall be installed.

F. The work shall include, but not be limited to, the following:

1. Connections to existing pipelines.

2. Test excavations necessary to locate or verify existing pipe and appurtenances.

3. Installation of all new pipe and materials required for a complete installation.

4. Cleaning, testing and disinfecting as required.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Division 1, General Requirements

B. Division 2, Sitework

C. Division 5, Metals

D. Division 9, Finishes

E. Division 11, Equipment

F. Division 16, Electrical

1.03 MATERIAL CERTIFICATION AND SHOP DRAWINGS

A. The Contractor shall furnish to the County (through the Engineer) a Material Certification stating that the pipe materials and specials furnished under this Section conform to all applicable provisions of the corresponding Specifications. Specifically, the Certification shall state compliance with the applicable standards (ASTM, AWWA, etc.) for fabrication and testing.

B. Shop Drawings for major piping (2-inches in diameter and greater) shall be prepared and submitted in accordance with Section 01300 – Submittals. In addition to the requirements of Section 01300 – Submittals, the Contractor shall submit laying schedules and detailed Drawings in plan and profile for all piping as specified and shown on the Drawings.

C. Shop Drawings shall include, but not be limited to, complete piping layout, pipe material, sizes, class, locations, necessary dimensions, elevations, supports, hanger details, pipe joints, and the details of fittings including methods of joint restraint. No fabrication or installation shall begin until Shop Drawings are approved by the Engineer.

PART 2 -- PRODUCTS

2.01 GENERAL

A. All specials and every length of pipe shall be marked with the manufacturer's name or trademark, size, class, and the date of manufacture. Special care in handling shall be exercised during delivery, distribution, and storage of pipe to avoid damage and unnecessary stresses. Damaged pipe will be rejected and shall be replaced at the Contractor's expense. Pipe and specials stored prior to use shall be stored in such a manner as to keep the interior free from dirt and foreign matter.

B. Testing of pipe before installation shall be as described in the corresponding ASTM or AWWA Specifications and in the applicable standard specifications listed in the

following sections. Testing after the pipe is installed shall be as specified in Section 3.09.

C. Joints in piping shall be of the type as specified in the appropriate Piping System Schedule at the end of this Section.

D. ALL BURIED EXTERIOR PIPING SHALL HAVE RESTRAINED JOINTS FOR THRUST PROTECTION UNLESS OTHERWISE SPECIFIED OR SHOWN ON THE DRAWINGS. ALL EXPOSED EXTERIOR PIPING SHALL HAVE FLANGED JOINTS, UNLESS OTHERWISE SPECIFIED OR SHOWN ON THE DRAWINGS.

E. The Drawings indicate work affecting existing piping and appurtenances. The Contractor shall excavate test pits as required of all connections and crossings which may affect the Contractor's work prior to ordering pipe and fittings to determine sufficient information for ordering materials. The Contractor shall take whatever measurements that are required to complete the work as shown or specified.

2.02 WALL PIPES

A. Where wall sleeves or wall pipes occur in walls that are continuously wet on one or both sides, they shall have water stop flanges at the center of the casting or as shown on the Drawings. Ends of wall pipes shall be flange, mechanical joint, plain end, or bell as shown on the Drawings, or as required for connection to the piping. Wall pipes shall be of the same material as the piping that they are connected to. If welded waterstop flanges are employed, welds shall be 360 degree continuous on both sides of flange. Unless otherwise shown on the Drawings, waterstop flanges shall conform to the minimum dimensions shown below:

Pipe Size	Waterstop Flange Diameter	Waterstop Flange Thickness
4" - 12"	OD + 3.10"	0.50"
14" - 24"	OD + 4.15"	0.75"
30" - 36"	OD + 4.50"	1.00"
42" - 48"	OD + 5.00"	1.25"
54"	OD + 5.90"	1.50"

2.03 SLEEVES

A. Unless shown otherwise, all piping passing through walls and floors shall be installed in sleeves or wall castings accurately located before concrete is poured, or placed in position during construction of masonry walls. Sleeves passing through floors shall extend from the bottom of the floor to a point 3 inches above the finished floor, unless shown otherwise. Water stop flanges are required on all sleeves located in floors or walls which are continually wet or under hydrostatic pressure on one or both sides of the floor or wall.

B. Sleeves shall be cast iron, black steel pipe, or fabricated steel in accordance with details shown on the Drawings. If not shown on the Drawings, the Contractor shall submit to the Engineer the details of sleeves he proposes to install; and no fabrication or installation thereof shall take place until the Engineer's approval is obtained. Steel sleeves shall be fabricated of structural steel plate in accordance with the standards and procedures of AISC and AWS. Steel sleeve surfaces shall receive a commercial sandblast cleaning and then be shop painted in accordance with Section 09900 – Painting.

C. When shown on the Drawings or otherwise required, the annular space between the installed piping and sleeve shall be completely sealed against a maximum hydrostatic pressure of 20 psig. Seals shall be mechanically interlocked, solid rubber links, trade name "Link-Seal", as manufactured by Garlock Pipeline Technologies (GPT) or equal. Rubber link, seal-type, size, and installation thereof, shall be in strict accordance with the manufacturer's recommendations. For non-fire rated walls and floors, pressure plate shall be glass reinforced nylon plastic with EPDM rubber seal and 304 stainless steel bolts and nuts. For fire rated walls and floors, two independent seals shall be provided consisting of low carbon steel, zinc galvanized pressure plates, silicon rubber seals and low carbon steel, zinc galvanized bolts and nuts.

D. Cast iron mechanical joint adapter sleeves shall be Clow # 1429, as manufactured by the Clow Corp., or equal. Mechanical joint adapter sleeves shall be provided with suitable gasket, follower ring, and bolts to effect a proper seal. In general, sleeves installed in walls, floors, or roofs against one side of which will develop a hydrostatic pressure, or through which leakage of liquid will occur, shall be so sealed. If welded waterstop flanges are employed, welds shall be 360 degree continuous on both sides of flange.

2.04 SOLID SLEEVE COUPLINGS (FOR BURIED SERVICE)

A. Solid sleeve couplings shall be used to connect buried service piping where shown on the Drawings. Solid sleeves shall be ductile iron, long body and shall conform to the requirements of ANSI A21.10 (AWWA C110). Unless otherwise shown or specified, solid sleeve couplings shall be Style A11760 as manufactured by American Cast Iron Pipe Co., or equal. Solid sleeve couplings shall be restrained with wedge-type restraining glands to meet the pressures specified.

B. Alternatively, EBAA Iron 3800 Mega-Coupling is acceptable.

2.05 FLANGED COUPLING ADAPTERS

A. Flanged coupling adapters shall be furnished as required and as shown on the Drawings.

B. Flanged coupling adapters shall be of ductile iron or carbon steel construction and shall be rated for the same pressure as the connected piping.

C. All flanged coupling adapters shall be harnessed by tying the adapter to the nearest pipe joint flange using threaded rods and rod tabs unless otherwise approved by the Engineer.

D. Flanged coupling adapters shall be manufactured by Smith-Blair Model 912 or 913, Romac Industries Model FCG or FC 400, Dresser Industries Model 128-W, or equal.

E. Flanged coupling adapters shall be provided with manufacturer's fusion bonded epoxy painting system.

2.06 DISMANTLING JOINTS

A. Dismantling joints shall be furnished at locations shown on the Drawings.

B. Dismantling joints for sizes less than 12-inch shall be of ductile iron or carbon steel construction and shall be rated for the same pressure as the connected piping. Dismantling joints for sizes greater than 12-inches shall be of carbon steel construction and shall be rated for the same pressure as the connected piping.

C. Flanges for dismantling joints shall match the bolt pattern and pressure rating of the flanges for the connected piping.

D. All dismantling joints shall be restrained utilizing restraining rods provided by the manufacturer. Restraining rods shall be constructed from ASTM A193 Grade B7 steel. Restraining rods and restraint system shall be installed in strict accordance with manufacturer's recommendations.

E. Dismantling joints shall be provided with manufacturer's fusion bonded epoxy painting system.

F. Dismantling joints shall be manufactured by Smith Blair Model 975, Romac Industries Model DJ400, or equal.

2.07 MECHANICAL COUPLINGS (SPLIT TYPE - GROOVED END)

A. Grooved end pipe couplings shall be furnished as specified or shown on the Drawings.

B. Materials shall be of malleable iron and couplings shall be rated for the same pressures as the connecting piping.

C. Gaskets shall be rubber. Bolts and nuts shall be heat treated carbon steel track bolts and shall be plated.

D. After installation, buried couplings shall receive two heavy coats of an approved coal tar which is compatible with the finish of the coupling. Exposed couplings shall be painted in accordance with Section 09900 - Painting.

E. Couplings shall be manufactured by Victaulic Company of America Style 31 or equal.

2.08 TAPPING SLEEVES AND TAPPING SADDLES

A. Tapping sleeves shall be similar to Mueller Outlet Seal, American Uniseal or Kennedy Square Seal. All sleeves shall have a minimum working pressure of 150 psi. All sleeves larger than twelve (12) inches shall be ductile iron. All taps shall be machine drilled; no burned taps will be allowed.

B. Tapping saddles may be used on mains sixteen (16) inches and larger where the required tap size does not exceed one-half the size of the main (i.e. 8-inch tapping saddle for use on a 16-inch main). Tapping saddles shall be manufactured of ductile iron providing a factor of safety of at least 2.5 at a working pressure of 250 psi. Saddles shall be equipped with a standard AWWA C-110-77 flange connection on the branch. Sealing gaskets shall be "O" ring type, high quality molded rubber having an approximate seventy durometer hardness, placed into a groove on the curved surface of the tapping saddles. Straps shall be of alloy steel. The tapping saddle shall be the American tapping saddle, U.S. Pipe tapping saddle, or equal. All taps shall be machine cut, no burned taps will be allowed.

2.09 UNIONS

A. For ductile iron, carbon steel, and grey cast iron pipes assembled with threaded joints and malleable iron fittings, unions shall conform to ANSI B16.39.

B. For copper piping, unions shall have ground joints and conform to ANSI B16.18.

C. For PVC and CPVC piping, unions shall be socket weld type with Viton O-ring.

2.10 THERMOPLASTIC TUBING AND FITTINGS

A. Thermoplastic tubing shall be manufactured from polyallomor tubing. Tubing shall be protected from ultraviolet radiation degradation with a black coating or integral color conforming to ASTM D-1248, Type 1, Class C, Category 3. Fittings and connectors used with thermoplastic tubing shall be the flareless tube type constructed of brass conforming to SAE CA377, SAE CA360 or equal. Brass sleeves shall be used.

B. Assembly of the thermoplastic tubing shall consist of pushing the tubing into the fitting and hand tightening the nut with final tightening with a wrench. Care shall be taken not to overtighten the nut. Plastic tube racks and bend holders shall be provided for holding the tubing in position. Needle valves used with thermoplastic tubing shall be the globe type constructed with a brass body, stem and seat and Buna-N "O"-ring seals. Installation shall be in accordance with the manufacturer's recommendations. Thermoplastic tubing, shall be the Impolene (polyallomor) system and needle valves, fittings and connectors shall be the Poly-Flo with 261 UB Universal Nut and Sleeve system as manufactured by Imperial Eastman, or equal.

2.11 HEAT TRACED PIPING

A. Exposed pipes to be insulated shall also be protected from freezing by heat tracing. Freeze protection heat tracing shall consist of twin 16 AWG copper brass wires with a semiconductor polymer core where electrical resistance varies with temperature. The heat tracing shall have a fluoropolymer outer jacket for corrosion resistance. The heat tracing shall be rated for three (3) watts per foot output, self-regulating with a maximum temperature of 150°F, equal to a Chromalox No. SRL3-1CT383400. Maximum length for tape shall be 300 feet for each circuit. Temperature controller shall be provided to sense pipe temperature to determine on or off condition of the heat tracing. Temperature control shall be equal to a Chromalox No. RTBC-2-384729. The heat tracing system shall operate on 120 VAC. See Drawings for installation detail.

2.12 FLEXIBLE RESTRAINED EXPANSION JOINTS

A. Restrained expansion joints shall be manufactured of 60-42-10 ductile iron conforming to material and other applicable requirements of ANSI/AWWA C153/A21.53.

B. Each pressure containing component shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the materials requirements of, and tested in accordance with, ANSI/AWWA C213 and shall meet or exceed the requirements of ANSI/AWWA C550.

C. Seals shall conform to the applicable requirements of ANSI/AWWA C111/A21.11.

D. All bolts used in the assemblies shall be stainless steel and shall be coated with a premium quality epoxy.

E. Flanged ends shall comply with ANSI/AWWA C110/A21.10, with the addition of O-ring groove and O-ring.

F. Mechanical joint ends shall comply with ANSI/AWWA C153/A21.53.

G. Restrained expansion joints shall have a minimum pressure rating of 350 psi with a minimum safety factor of 3:1. Each assembly shall be tested at 350 psi before shipment.

H. Restrained expansion joints shall provide for self restraint without tie rods and shall provide for expansion and contraction capabilities cast as an integral part of the end connection.

I. Flexible restrained expansion joints shall allow for 8-inches (+6"-2") minimum expansion.

J. Flexible restrained expansion joints shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint having a minimum of 15□ deflection per ball.

K. Restrained expansion joints shall be the Single Ball or Double Ball FLEX-TEND Expansion Joint as manufactured by EBAA Iron Inc., or equal.

2.13 PVC TUBING

A. PVC Tubing shall be in accordance with Section 15085, Chemical Tubing.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. All piping shall be installed by skilled workmen and in accordance with the best standard practice for piping installation as shown on the Drawings, specified or recommended by the pipe manufacturer. Proper tools and appliances for the safe and convenient handling and installing of the pipe and fittings shall be used. Great care shall be taken to prevent any pipe coating from being damaged on the inside or outside of the pipe and fittings. All pieces shall be carefully examined for defects, and no piece shall be installed which is known to be cracked, damaged, or otherwise defective. If any defective pieces should be discovered after having been installed, it shall be removed and replaced with a sound one in a satisfactory manner by the Contractor and at his own expense. Pipe and fittings shall be thoroughly cleaned before they are installed and shall be kept clean until they are accepted in the complete work. All piping connections to equipment shall be provided with unions or coupling flanges located so that piping may be readily dismantled from the equipment. At certain applications, Dresser, Victaulic, or equal, couplings may also be used. All piping shall be installed in such a manner that it will be free to expand and contract without injury to itself or to structures and equipment to which it is connected. All piping shall be erected to accurate lines and grades with no abrupt changes in line or grade and shall be supported and braced against movement, temporary, or permanent. All exposed piping shall be installed with vertical and horizontal angles properly related to adjoining surfaces or pipes to give the appearance of good workmanship. Unless otherwise shown or approved, provided a minimum headroom clearance under all piping of 7 feet 6 inches.

B. Unless otherwise shown or specified, all waste and vent piping shall pitch uniformly at a 1/4-inch per foot grade and accessible cleanouts shall be furnished and installed as shown and as required by local building codes. Installed length of waste and vent piping shall be determined from field measurements in lieu of the Drawings.

C. All excavation shall be made in such a manner and to such widths as will provide ample room for properly installing the pipe and permit thorough compaction of backfill around the pipe. The minimum trench widths shall be in strict accordance with the "Trench Width Excavation Limits" as shown on the Drawings. All excavation and trenching shall be done in strict accordance with these specifications and all applicable parts of the OSHA Regulations, 29CFR 1926, Subpart P.

D. ALL EXCAVATION REQUIRED BY THIS CONTRACT SHALL BE UNCLASSIFIED. NO ADDITIONAL PAYMENT WILL BE MADE FOR ROCK EXCAVATION REQUIRED FOR THE INSTALLATION OF PIPE OR STRUCTURES SHOWN ON THE DRAWINGS.

E. Enlargements of the trench shall be made as needed to give ample space for operations at pipe joints. The width of the trench shall be limited to the maximum dimensions shown on the Drawings, except where a wider trench is needed for the installation of and work within sheeting and bracing. Except where otherwise specified, excavation

slopes shall be flat enough to avoid slides which will cause disturbance of the subgrade, damage to adjacent areas, or endanger the lives or safety of persons in the vicinity.

F. Hand excavation shall be employed wherever, in the opinion of the Engineer, it is necessary for the protection of existing utilities, poles, trees, pavements, or obstructions.

G. No greater length of trench in any location shall be left open, in advance of pipe laying, than shall be authorized or directed by the Engineer and, in general, such length shall be limited to approximately one hundred (100) feet. The Contractor shall excavate the trenches to the full depth, width and grade indicated on the Drawings including the relevant requirements for bedding. The trench bottoms shall then be examined by the Engineer as to the condition and bearing value before any pipe is laid or bedding is placed.

H. No pressure testing shall be performed until the pipe has been properly backfilled in place. All pipe passing through walls and/or floors shall be provided with wall pipes or sleeves in accordance with the specifications and the details shown on the Drawings. All wall pipes shall be of ductile iron and shall have a water stop located in the center of the wall. Each wall pipe shall be of the same class, thickness, and interior coating as the piping to which it is joined. All buried wall pipes shall have a coal tar outside coating on exposed surfaces.

I. JOINT DEFLECTION SHALL NOT EXCEED 75 PERCENT OF THE MANUFACTURERS RECOMMENDED DEFLECTION. Excavation and backfilling shall conform to the requirements of Section 02200 - Earthwork, and as specified herein. Maximum trench widths shall conform to the Trench Width Excavation Limits shown on the Drawings. All exposed, submerged, and buried piping shall be adequately supported and braced by means of hangers, concrete piers, pipe supports, or otherwise as may be required by the location.

J. Following proper preparation of the trench subgrade, pipe and fittings shall be carefully lowered into the trench so as to prevent dirt and other foreign substances from gaining entrance into the pipe and fittings. Proper facilities shall be provided for lowering sections of pipe into trenches. UNDER NO CIRCUMSTANCES SHALL ANY OF THE MATERIALS BE DROPPED OR DUMPED INTO THE TRENCH.

K. Water shall be kept out of the trench until jointing and backfilling are completed. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no water, earth, or other substance will enter the pipes, fitting, or valves. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored as required.

L. All piping shall be installed in such a manner that it will be free to expand and/or contract without injury to itself or to structures and equipment to which it is connected. All piping shall be erected to accurate lines and grades with no abrupt changes in line or grade and shall be supported and braced against movement, temporary, or permanent. All exposed piping shall be installed with vertical and horizontal angles properly related to adjoining surfaces or pipes to give the appearance of good workmanship. Pipes crossing within a vertical distance of less than or equal to one (1) foot shall be encased

and supported with concrete at the point of crossing to prevent damage to the adjacent pipes as shown on the Drawings.

M. The full length of each section of pipe shall rest solidly upon the bed of the trench, with recesses excavated to accommodate bells, couplings, joints, and fittings. Before joints are made, each pipe shall be well bedded on a solid foundation; and no pipe shall be brought into position until the preceding length has been thoroughly bedded and secured in place. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid by the Contractor at his own expense. Pipe shall not be laid in water or when trench conditions are unsuitable for work.

N. Proper and suitable tools and appliances for the safe convenient handling and laying of pipe shall be used and shall in general agree with manufacturer's recommendations.

O. AT THE CLOSE OF EACH WORK DAY THE END OF THE PIPELINE SHALL BE TIGHTLY SEALED WITH A CAP OR PLUG SO THAT NO WATER, DIRT, OR OTHER FOREIGN SUBSTANCE MAY ENTER THE PIPELINE, AND THIS PLUG SHALL BE KEPT IN PLACE UNTIL PIPE LAYING IS RESUMED.

P. During the laying of pipe, each pipe manufacturer shall provide his own supervisor to instruct the Contractor's pipe laying personnel in the correct procedure to be followed.

Q. Ordinarily only full lengths of pipe (as furnished by the pipe manufacturer) shall be used exceptions: closure pieces at manholes and areas where joint deflection is required.

R. For gravity sewer installations, the Contractor shall use a laser device to maintain the trench and pipe alignment. The laser device shall be re-checked for correct elevation and pipe alignment prior to pipe installation if the device is left in the pipe overnight. Corrected invert elevations at each manhole and any adjustments will be coordinated and approved by the Engineer.

S. ALL PIPING SHALL HAVE TYPE "A" BEDDING AS SHOWN ON THE DRAWINGS, UNLESS OTHERWISE SPECIFIED HEREIN OR INDICATED ON THE DRAWINGS.

T. Detector tape shall be installed 12 inches below final grade and directly above all buried potable water piping. The tape shall be blue and silver and shall be clearly and permanently labeled "Water". Detector tape shall be Lineguard III as manufactured by Lineguard, Inc., or equal.

U. At the close of work each day pipeline trenches shall be backfilled up to the end of the pipe being installed.Any areas left open shall be properly sloped and shall be fully protected in accordance with local/state ordinances (by berms, caution tape, barricades, etc.). In paved areas the surface shall be restored as specified in section 02150, paving and surfacing, to allow for traffic over the trench during non-working areas.

3.02 REINFORCED CONCRETE PIPE, CONCRETE CULVERT, AND DRAIN PIPE

A. The laying of reinforced concrete pipe shall conform to the applicable sections of the Concrete Pipe Handbook as published by the American Concrete Pipe Association.

3.03 PRESTRESSED CONCRETE PIPE

A. The laying of prestressed concrete pipe shall be in accordance with the manufacturer's recommendations and shall conform to the applicable sections of AWWA Manual M-9. Prior to assembling the spigot end into the bell end, both ends shall be thoroughly cleaned and the rubber gasket and the bell end of the previously laid pipe shall be coated with vegetable soap furnished by the manufacturer.

B. For each crew that is inexperienced in laying this type of pipe, one reliable man shall be furnished by the manufacturer's representative with and instructed in the use of a set of steel inserts and feeler gauge to be used in determining if the rubber gasket is in proper position prior to the joint being pushed or pulled home. An experienced crew may omit the use of a feeler gauge. In either method of operation, the Contractor shall be responsible for a good, proper and sound joint. Any joint found in later tests to be faulty shall be repaired to the satisfaction of the Engineer.

C. After the pipe is "home" a cloth diaper (minimum 7-inches wide) supplied by the pipe manufacturer shall be placed and wired around the outside of the pipe at the joint. This diaper shall serve as a form for pouring a 1:2 cement-sand grout in the external recess.

D. Great care shall be taken to prevent the concrete core or jacket or the steel bell and spigot rings from being damaged, and any core, jacket or ring damaged in any way shall be repaired or replaced by the Contractor to the satisfaction of the Engineer.

3.04 DUCTILE IRON PIPE

A. Ductile iron pipe (DIP) shall be installed in accordance with the requirements of the Ductile Iron Pipe Handbook published by the Ductile Iron Pipe Research Association, and AWWA C600.

B. Where it is necessary to cut ductile iron pipe in the field, such cuts shall be made carefully in a neat workmanlike manner using approved methods to produce a clean square cut. The outside of the cut end shall be conditioned for use by filing or grinding a small taper, at an angle of approximately 30 degrees.

C. UNLESS OTHERWISE APPROVED BY THE ENGINEER, FIELD WELDING OF DUCTILE IRON WILL NOT BE PERMITTED.

3.05 PVC/CPVC AND HDPE PIPE

A. Polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC) and High Density Polyethylene (HDPE) pipe shall be laid and joints assembled according to the respective manufacturer's recommendation. PVC pipe installation shall comply with applicable sections of the Uni-Bell PVC Pipe Association Recommended Standard Specifications.

B. Plastic piping shall not be installed when the temperature is less then 60□F except as otherwise recommended by the manufacturer and approved by the Engineer.

3.06 CARBON AND STAINLESS STEEL PIPE

A. Installation of steel pipe shall be by skilled workmen and shall conform to the applicable sections of AWWA Manual M-11. Joints for steel piping shall be either screwed, welded, or flanged as shown on the Drawings or as specified.

B. Welding in the field shall be performed only when requested on the shop drawings and permitted by the Engineer for carbon steel pipe. No welding of stainless steel pipe shall be allowed in the field. All field welds shall be radiographically inspected.

C. Installation of the steel casing pipe shall be by skilled workmen and in accordance with the best standard practice for steel pipe installation. Joints for steel casing pipe shall be butt welded.

1. The boring equipment to be used for installing the jacked casing shall be of such size and capacity to allow the boring to proceed in a safe and expeditious manner. The installation of the casing and boring of the hole shall be done simultaneously to avoid cave-ins or settlement and for safety of traffic above.

2. The Contractor shall check the vertical and horizontal alignment of the casing by survey instrument at least once during each four feet of advance, or as directed by the Engineer. Pits shall be well sheeted and braced as necessary for safe and adequate access for workmen, inspectors and materials and shall be of a size suitable to equipment and material handling requirements.

3. Under no conditions shall jetting or wet boring of encasement under pavement be allowed.

4. After installation of the carrier pipe, each end of the casing pipe shall be made watertight with a brick masonry bulkhead. In addition, a Class B concrete cradle shall be provided from each end of the bulkhead to the first pipe joint outside of the bulkhead.

3.07 COPPER PIPE

A. Installation of copper pipe shall be by skilled workman in accordance with the manufacturer's recommendations. Use teflon tape at all fittings unless otherwise required for intended service. Install unions at the connections to each piece of equipment to allow removal of equipment without dismantling connecting piping.

B. Wall sleeves shall be provided for all piping passing through exterior walls and shall be of the same material as the piping to which it is joined. All wall sleeves shall be provided with an acceptable waterstop.

C. The Contractor shall provide hot and cold water mains with branches and risers complete from point indicated on the Drawings running to all fixtures and other outlets indicated. Mains and branches shall be run generally as shown on the Drawings. The Contractor shall provide all interior water piping, branches, and risers as shown on the

Drawing and shall make connections to all plumbing fixtures, hose bibs, wall hydrants, and other points requiring water under this and other Divisions of the Specifications.

D. All water mains and branches shall be pitched at least one (1) inch in twenty-five (25) feet toward fixtures. The piping installation shall be arranged so that the entire system can be drained through fixture supply connections.

E. Unions shall be installed at the connections to each piece of equipment to allow for removal of equipment without dismantling connecting piping.

F. Joints 1-1/4 inches and larger shall be made with silver solder. For joints less than 1-1/4 inches and all valves (regardless of size) use 95/5 solder. Soldered joints shall be prepared with a non-corrosive paste flux in accordance with manufacturer's instructions. All joints shall be thoroughly cleaned with emery cloth and reamed out before assembly. Acid core solder will not be permitted.

3.08 POLYPROPYLENE AND POLYVINYLIDENE FLUORIDE PIPE

A. The pipe and fittings shall be of the same material for both inner and outer walls of the pipe.

B. Polypropylene pipe shall be black UV stabilized co-polymer conforming to the requirements of ASTM D-4101. Where used in exterior locations, material shall provide a weathering resistance absent of further coating, covering, or wrapping unless specified herein or shown on the Drawings.

C. Polyvinylidene flouride shall comply with ASTM D-3222. The material shall provide a translucence, thus enabling a visual inspection of liquid in the annular space between the inner and outer walls.

D. Where elastomers are selected by the manufacturer, such selection shall be with regard to the application of the chemical solution to be transported.

E. Pipe and associated fittings shall be rated for not less than 75 psi at 73°F.

F. Double-walled pipe and fittings shall be molded and used throughout. Molded ribs shall maintain permanent alignment of the inner and outer walls of the pipe and fittings.

G. Ends of fittings shall be flush, creating a single plane.

H. Wall thickness of the inner and outer walls of double-walled pipe shall be identical, providing identical pressure ratings.

I. Where shown on the Drawings, a leak detection system of the manufacturer's design shall be supplied, complete with vent pipes, manual drain outlet, and electric float switch. Switch shall be rated for 0.080 amps at 120 VAC.

J. Polypropylene and polyvinylidene flouride pipe shall be laid and joints assembled by skilled workers according to the respective manufacturer's recommendations. Joints shall be butt fusion welded.

K. Plastic piping shall not be installed when the ambient temperature is less than 60°F except as otherwise recommended by the manufacturer and approved by the Engineer.

L. Wall sleeves shall be provided where piping passes through exterior walls. All sleeves shall be provided with an acceptable waterstop.

M. Double walled pipe shall be Asahi/American or equal. Pipe shall be furnished complete with flanges or other appurtenant fittings by the same manufacturer and made especially for use with the double walled pipe.

3.09 JOINTS IN PIPING

A. Restrained joints shall be provided on all pipe joints as specified herein and shown on the Drawings. Restrained joints shall be made up similar to that for push-on joints.

B. Push-on joints include a single rubber gasket which fits into the bell end of the pipe. The gasket shall be wiped clean, flexed and then placed in the socket. Any bulges in the gasket which might interfere with the entry of the plain end of the pipe shall be removed. A thin film of lubricant shall be applied to the gasket surface which will come into contact with the spigot end of the pipe. The lubricant shall be furnished by the pipe manufacturer. The plain end of the pipe, which is tapered for ease of assembly, shall be wiped clean and a thick film of lubricant applied to the outside. The pipe shall be aligned and carefully entered into the socket until it just makes contact with the gasket. The joint assembly shall be completed by entering the pipe past the gasket until it makes contact with the bottom of the socket. The pipe shall be pulled "home" with an approved jack assembly as recommended by the pipe manufacturer. If assembly is not accomplished by reasonable force, the plain end shall be removed, and the condition corrected.

C. Flanged joints shall be brought to exact alignment and all gaskets and bolts or studs inserted in their proper places. Bolts or studs shall be uniformly tightened around the joints. Where stud bolts are used, the bolts shall be uniformly centered in the connections and equal pressure applied to each nut on the stud. Pipes in all lines subject to temperature changes shall be cut short and cold sprung into place to compensate for expansion when hot.

D. Mechanical joints shall be made up with gaskets, glands and bolts. When a joint is to be made up, the bell or socket and plain end shall be cleaned and washed with a solution of mild soap in water; the gland and gasket shall be slid onto the plain end and the end then entered into the socket until it is fully "home" on the centering ring. The gasket shall then be painted with soapy water and slid into position, followed by the gland. All bolts shall be inserted and made up hand tight and then tightened alternately to bring the gland into position evenly. Excessive tightening of the bolts shall be avoided. All nuts shall be pulled up using a torque wrench which will not permit unequal stresses in the bolts. Torque shall not exceed the recommendations of the manufacturer of the pipe and bolts for the various sizes. Care shall be taken to assure that the pipe remains fully "home" while the joint is being made. Joints shall conform to the applicable AWWA Specifications.

E. Threaded and/or screwed joints shall have long tapered full depth threads to be made with the appropriate paste or jointing compound, depending on the type of fluid to be processed through the pipe. All pipe up to, and including 1-1/2-inches, shall be reamed to remove burr and stood on end and well pounded to remove scale and dirt. Wrenches on valves and fittings shall be applied directly over the joint being tightened. Not more than three pipe threads shall be exposed at each connection. Pipe, in all lines subject to temperature changes shall be cut short and cold sprung into place to compensate for expansion when hot. Joints in all piping used for chlorine gas lines shall be made up with a glycerine and litharge cement. Joints in plastic piping (PVC/CPVC) shall be laid and joints made with compounds recommended by the manufacturer. Installation shall conform to the requirements of ASTM D2774 and ASTM D2855. Unions required adjacent to valves and equipment.

F. Soldered joints shall have the burrs removed and both the outside of pipe and the inside of fittings shall be thoroughly cleaned by proper tools recommended for that purpose. Flux shall be applied to both pipe and inside of fittings and the pipe placed into fittings and rotated to insure equal distribution of flux. Joints shall be heated and solder applied until it shows uniformly around the end of joints between fitting and pipe. All joints shall be allowed to self-cool to prevent the chilling of solder. Combination flux and solder paste manufactured by a reputable manufacturer is acceptable. Unions required adjacent to valves and equipment.

G. Welded joints shall be made by competent operators in a first class workmanlike manner, in complete accordance with ANSI B31.1 and AWWA C206. Welding electrodes shall conform to ASTM A233, and welding rod shall conform to ASTM A251. Only skilled welders capable of meeting the qualification tests for the type of welding which they are performing shall be employed. Tests, if so required, shall be made at the expense of the Contractor, if so ordered by the Engineer. Unions shall be required adjacent to valves and equipment.

H. Copper joints shall be thoroughly cleaned and the end of pipes uniformly flared by a suitable tool to the bevels of the fittings used. Wrenches shall be applied to the bodies of fittings where the joint is being made and in no case to a joint previously made. Dimensions of tubing and copper piping shall be in complete accordance with the fittings used. No flare joints shall be made on piping not suited for flare joints. Installations for propane gas shall be in accordance with NFPA 54 and/or 58.

I. Solvent or adhesive welded joints in plastic piping shall be accomplished in strict accordance with the pipe manufacturer's recommendations, including necessary field cuttings, sanding of pipe ends, joint support during setting period, etc. Care shall be taken that no droppings or deposits of adhesive or material remain inside the assembled piping. Solvent or adhesive material shall be compatible with the pipe itself, being a product approved by the pipe manufacturer. Unions are required adjacent to valves and equipment. Sleeve-type expansion joints shall be supplied in exposed piping to permit 1-inch minimum of expansion per 100 feet of pipe length.

J. Dielectric isolation such as flange isolation kits, dielectric unions, or similar, shall be installed wherever dissimilar metals are connected according to the following table.

	Zinc	Galvanized Steel	Aluminum	Cast Iron	Ductile Iron	Mild Steel/ Carbon Steel	Copper	Brass	Stainless Steel
Zinc			●	●	●	●	●	●	●
Galvanized Steel			●	●	●	●	●	●	●
Aluminum	●	●		●	●	●	●	●	●
Cast Iron	●	●	●				●	●	●
Ductile Iron	●	●	●				●	●	●
Mild Steel/ Carbon Steel	●	●	●				●	●	●
Copper	●	●	●	●	●	●			●
Brass	●	●	●	●	●	●			●
Stainless Steel	●	●	●	●	●	●	●	●	

1. "●" signifies dielectric isolation is required between the two materials noted.
2. Consult Engineer for items not listed in table.
3. Provide flange isolation kits for all flanged connections of dissimilar metals and hardware including connections to equipment.
4. Contractor shall include all isolation descriptions with piping submittals.

K. Eccentric reducers shall be installed where air or water pockets would otherwise occur in mains because of a reduction in pipe size.

L. Joints in polypropylene and polyvinylidelene fluoride pipe shall be butt fusion weld. All butt welding shall follow the requirements of ASTM D-2657 and the manufacturer's recommendations.

3.10 FLUSHING AND TESTING

A. All piping shall be properly flushed and tested unless specifically exempted elsewhere in the Specifications or otherwise approved by the Engineer. Air and gas pipelines shall be flushed and tested with compressed air. Gravity sewer piping shall be flushed and tested as specified in Division 2. All other liquid conveying pipelines shall be flushed and tested with water. The Contractor shall furnish and install all means and apparatus necessary for getting the air or water into the pipeline for flushing and testing including pumps, compressors, gauges, and meters, any necessary plugs and caps, and any

required blow-off piping and fittings, etc., complete with any necessary reaction blocking to prevent pipe movement during the flushing and testing. All pipelines shall be flushed and tested in such lengths or sections as agreed upon among the County, Engineer, and Contractor. Test pressures shall be as specified in Section 15995 – Pipeline Testing, and shall be measured at the lowest point of the pipe segment being tested. The Contractor shall give the County and Engineer reasonable notice of the time when he intends to test portions of the pipelines. The Engineer reserves the right, within reason, to request flushing and testing of any section or portion of a pipeline.

B. The Contractor shall provide water for all flushing and testing of liquid conveying pipelines. Raw water or non-potable water may be used for flushing and testing liquid pipelines not connected to the potable water system. Only potable water shall be used for flushing and testing the potable water system.

C. Air and gas piping shall be completely and thoroughly cleaned of all foreign matter, scale, and dirt prior to start-up of the air or gas system.

D. At the conclusion of the installation work, the Contractor shall thoroughly clean all new liquid conveying pipe by flushing with water or other means to remove all dirt, stones, pieces of wood, etc., which may have entered the pipe during the construction period. If after this cleaning any obstructions remain, they shall be corrected by the Contractor, at his own expense, to the satisfaction of the Engineer. Liquid conveying pipelines shall be flushed at the rate of at least 2.5 feet per second for a duration suitable to the Engineer or shall be flushed by other methods approved by the Engineer.

E. Compressed/service air and gas piping shall be flushed by removing end caps from the distribution lines and operating one (1) compressor, in accordance with the manufacturer's instructions.

F. After flushing, all air piping shall be pressure and leak tested prior to coating and wrapping of welded joints. Immediately upon successful completion of the pressure and leak test, welded joints shall be thoroughly cleaned of all foreign matter, scale, rust, and discoloration and coated in accordance with the Specifications.

G. All process air piping shall be leak tested by applying a soap solution to each joint. Leak tests shall be conducted with one (1) blower in service at normal operating pressure.

H. During testing the piping shall show no leakage. Any leaks or defective piping disclosed by the leakage test shall be repaired or replaced by the Contractor, at his own expense, and the test repeated until all such piping shows tight.

I. All buried process air piping shall be pressurized to 25 psig and tested for leaks by applying a soap solution to each joint. The air supply shall be stopped and the pipe pressure monitored. System pressure shall not fall by more than 0.5% of the 25 psig test pressure over a one-hour test period. Should the system fail to hold the required pressure for one hour, the cause shall be determined and corrected and the test repeated until a successful test of the entire system is obtained.

J. Field leakage tests shall be performed for all submerged process air piping. The procedure shall consist of operating the system under clear nonpotable water for visual identification of all leaks. All field leakage tests shall be witnessed by the Engineer. All submerged piping shall be installed free of any leaks.

K. After flushing, all liquid conveying pipelines shall be hydrostatically tested at the test pressure specified in Section 15995 – Pipeline Testing. The procedure used for the hydrostatic test shall be in accordance with the requirements of AWWA C600. Each pipeline shall be filled with water for a period of no less than 24 hours and then subjected to the specified test pressure for 2 hours. During this test, exposed piping shall show no leakage. Allowable leakage in buried piping shall be in accordance with AWWA C600.

L. Any leaks or defective pipe disclosed by the hydrostatic test shall be repaired or replaced by the Contractor, at his own expense, and the test repeated until all such piping shows tight.

M. After flushing, all gas piping shall be leak tested in accordance with all local codes and regulations and in conformance with the recommendations or requirements of any National Institute or Association for the specific service application.

3.11 DISINFECTION

A. All pipe and fitting connected to and forming a part of a potable water supply shall be disinfected in accordance with the procedures described in AWWA C 651. Disinfection shall also be in accordance with the requirements of the Florida Division of Environmental Health and the County.

B. Disinfection shall be accomplished after the pipe has been flushed, if applicable, and passed the hydrostatic test. Such piping shall be filled with 50 parts per million (PPM) of chlorine and held in contact for not less than 24 hours. Final tests after 24 hours contact time shall show a minimum residual chlorine content of 10 ppm in all parts of the system. Disinfection shall be repeated as often as necessary, and as directed by the Engineer and/or FDEH and/or the County until the minimum residual chlorine content of 10 ppm has been reached. The Contractor shall obtain certificates of satisfactory bacteriological tests and furnish them to the County before the request is made for acceptance of the work. The Contractor shall furnish and install, at his own expense, all means and apparatus necessary for performing the disinfection. The chlorine solution shall be thoroughly flushed out prior to placing the new sections of pipe in service. The Contractor is cautioned that the spent chlorine solution must be disposed of in such a way as not to be detrimental to animal, plant, or fish life. Chlorine residual tests will be made after flushing to assure that residual is not in excess of 1 ppm at any point in system.

3.12 PAINTING AND COLOR CODING SYSTEM

A. All exposed piping specified shall be color coded in accordance with the County's standard color designation system for pipe recognition and in accordance with Section 15030 – Piping and Equipment Identification Systems. In the absence of a standard

color designation system, the Engineer will establish a standard color designation for each piping service category from color charts submitted by the Contractor in compliance with Section 09900 – Painting.

B. All piping specified in this Section shall be painted in accordance with Section 09900 – Painting, except as follows:

1. Copper pipe

2. Stainless steel pipe. Flanges and supports or hangers shall be painted.

3.13 PIPING SCHEDULE

A. This section includes schedule of piping specified in other sections of Division 15 – Mechanical Construction.

B. The following abbreviations are used in the schedule:

1. Material

A20 - Alloy 20
BSP - Black Steel Pipe
CIP - Cast Iron Pipe
CMP - Corrugated Metal Pipe
CPVC - Chlorinated Polyvinyl Chloride
CSP - Carbon Steel Pipe
Cu - Copper
DIP - Ductile Iron Pipe
GSP - Galvanized Steel Pipe
HDPE - High Density Polyethylene
SS - 316L Stainless Steel
PP - Polypropylene
PVC - Polyvinylchloride
PVDF - Polyvinylidene Fluoride

2. Wall Thickness

CL - Class
DR - Diameter Ratio
Sch - Schedule
SDR - Standard Diameter Ratio

3. Joint Type

Grvd - Grooved
Flg - Flanged
PO - Push-on
RJ - Restrained Joint
MJ - Mechanical Joint

Sld - Soldered
SW - Solvent Welded
Thd - Threaded
Wld - Welded
Comp - Compression Fitting
FW - Fusion Welded

1. Fitting Type
   A20 - Alloy 20
   SS - 316L Stainless Steel
   DIP - Ductile Iron Pipe
   PVC - Polyvinylchloride
   Gal - Galvanized
   CSP - Carbon Steel Pipe
   BSP - Black Steel Pipe
   Cu - Copper
   PP - Polypropylene

5. Interior Surface Protection

   ACCL - Asphalt Coated Cement Lined
   CML - Cement Mortar Lined
   EL - Epoxy Lined
   PE - Polyethylene Lined

6. Exterior Surface Protective Coating

   AC - Asphalt Coated
   P - Painted
   Gal - Galvanized

C. Piping Schedule

Service	Abbreviation	Material	Thickness Class or Schedule	Working Pressure (PSIG)	Type of Joints	Type of Fittings	Protective Coating		Remarks
							Interior	Exterior	
GRAVITY DRAIN / CENTRATE Above Ground	DR / CEN	DIP	Note 1	5	Flg	DIP	EL	P	
Below Ground		PVC	C900	5	PO	DIP	--	--	
PLANT WATER Above Ground	PWTR	PVC	Sch 80	70	SW	PVC	--	P	Note 2
Below Ground		PVC	C900	70	PO	DIP	--	--	Note 2
DIGESTED SLUDGE	DS	DIP	Note 1	50	Flg	DIP	EL	P	
POLYMER SUPPLY	POLYMER	PVC	Sch 80	100	SW	PVC	--	P	
SODIUM HYPOCHLORITE (ABOVE GROUND)	SH	PVC	Sch 80	100	Note 2	Note 2	--	P	Note 2
SODIUM HYPOCHLORITE FEED (BELOW GROUND CARRIER PIPE)	SH	PVC	Tubing	100	Insert	Manufacturer recommended	--	--	
SODIUM HYPOCHLORITE FEED (BELOW GROUND CONTAINMENT PIPE)	SH	PVC	Sch 40	5	SW	PVC	--	--	
VENT	VNT	PVC	Sch 80	Ambient	SW	PVC	--	P	
BACKWASH WATER	BKWW	DIP	Note 1	50	RJ	DIP	EL		
SURGE RELIEF	SR	SS	Sch 10	65	Flg/Thd	SS	--	--	

Notes:
[1] Refer to Section 15006 for Ductile Iron Pipe
[2] Refer to Section 15009 for PVC Pressure Pipe

- END OF SECTION –

SECTION 15006

DUCTILE IRON PIPE

PART 1 -- GENERAL

1.01 WORK INCLUDED

A. The CONTRACTOR shall furnish and install ductile iron pipe and all appurtenant Work, complete in place, all in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02222 – Excavation and Backfill for Utilities

B. Section 01300 - Submittals

C. Section 09900 - Painting

D. Section 15000 – Basic Mechanical Requirements

E. Section 15995 – Pipeline Testing and Disinfection

1.03 REFERENCED SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

ANSI/AWWA C110/A21.10	Ductile-Iron and Gray-Iron Fittings 3-in. Through 48-in. for Water and Other Liquids
ANSI/AWWA C111/A21.11	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
ANSI/AWWA C150/A21.50	Thickness Design of Ductile Iron Pipe
ANSI/AWWA C151/A21.51	Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
ANSI/AWWA C600	Installation of Ductile-Iron Water Mains and Appurtenances

1.04 SUBMITTALS

A. Shop Drawings: The CONTRACTOR shall submit Shop Drawings of pipe and fittings in accordance with the requirements set forth in Section 15000 entitled “Piping, General” and Section 01300 entitled “Submittals”.

1.05 SCHEDULE OF PIPING MATERIALS

A. A schedule of piping is included in Section 15000 entitled “Piping, General” which includes service, nominal pipe sizes, materials, wall thicknesses, pressures, coatings and other design requirements.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Pipe shall be centrifugally cast in metal molds or sand lined molds in accordance with ANSI A21.51 (AWWA C151) of grade 60-42-10 ductile iron. The above standard covers ductile iron pipe with nominal pipe sizes from 3 inches up to and including 64 inches in diameter. Working pressure for the pipe shall be 150 psi or as otherwise identified in the pipe schedule.

B. Wall Thickness

1. The following design parameters shall be provided for all ductile iron piping unless specified otherwise in the pipe schedule. This wall thickness shall conform to the following classes of AWWA C150, as specified in Table 50.15, Special Thickness Classes of Ductile Iron Pipe for the following sizes unless noted otherwise in the schedule. Flanged pipe shall not be less than Class 53 as identified in Table 50.15 of AWWA C150.

PIPE MATERIAL	NOMINAL PIPE DIAMETER (INCHES)	CLASS	TYPE OF JOINT
DI	4 thru 12	52	RJ
	14 thru 54	51	RJ
DI	All	53	FLG

2. Where groove type couplings are used, the wall thickness shall be increased by one Class.

C. Joints (Flanged)

1. Ductile iron pipe above grade shall be flanged unless otherwise shown on the Drawings.

2. Flanges for flanged pipe shall be in accordance with ANSI A21.15 (AWWA C115), shall be ductile iron, shall be manufactured in the United States, shall be rated at 250 psi maximum working pressure, and shall be similar to flange Class 125 per ANSI B16.1. Fittings shall be provided with flanges having a bolt circle and bolt pattern the same as the adjacent pipe and/or mechanical devices. Joint materials shall be ANSI sized and approved and shall consist of bolts and nuts conforming to Section 15000 entitled “Piping, General” and full faced 1/8" thick neoprene gaskets.

3. No raised face flanges shall be used.

D. Joints (Restrained)

1. Ductile iron pipe below grade shall be restrained joint.

2. Restrained joint pipe and fittings shall be Flex-Ring or Lok-Ring type as manufactured by American Cast Iron Pipe, TR Flex as manufactured by U.S. Pipe, or equal.

3. Mechanical joint valves shall be restrained by manufactured MJ coupled glands where installed in new pipe. New pipe being connected to existing mechanical joints and pipe being connected to fittings, for which restrained joints named in paragraph D.2 above are not available, shall be restrained by MJ coupled glands.

4. The above systems shall be used where restrained joint ductile iron pipe is specified. Thrust restraint and harnessing systems which use a restrained mechanical joint follower gland and operate on a wedging principal such as MEGA LUG Series 1100 by EBAA Iron or equal, shall not be used unless specifically allowed by the ENGINEER in isolated applications such as connections to valves, existing piping, walls, buried, etc. Where tie-rods are allowed, the rods and tabs shall be designed for the specified design pressure, shall have lengths less than ten feet between fittings and shall be painted with two heavy coats of coal tar epoxy after installation.

E. Fittings

1. Fittings shall be manufactured in accordance with ANSI A21.10 (AWWA C110) for nominal pipe sizes 3 inches to 64 inches, and shall be flanged for above-ground applications and restrained joint for below-ground applications unless otherwise shown on the Drawings. Any other fittings, not included in ANSI A21.10 (AWWA C110) shall conform in design and performance to the requirements of this standard.

2. Fittings shall have a rated pressure equal to or greater than the specified working pressure for nominal pipe sizes of three inches to sixty-four inches (350 psi fittings available through and including twenty-four inches, only).

3. Gray iron fittings, which conform to the specifications contained herein, may be used with ductile iron pipe providing the piping systems minimum working pressure is met or exceeded.

4. Blind, filler, companion and reducing flanges shall conform to ANSI B16.1.

F. Pipe Coating: All ductile iron pipe and fittings shall be supplied with the same coating material throughout the project. Coating shall be provided in the interior and exterior of the pipe as described hereinafter.

1. Shop Coat Exterior Primer, Aboveground Piping: A high solids (3.0-8.0 mils DFT) primer, compatible with the coating system specified in Section 09900 entitled “Painting”, shall be applied prior to shipment.

2. Field Exterior Coat, Aboveground Piping: Final coating shall be applied in field in accordance with Section 09900 entitled “Painting”.

3. Shop Coating Exterior, Buried Piping: Asphaltic coating applied prior to shipment to the exterior wall of buried pipe and fittings in accordance with ANSI A21.51 (AWWA C151).

4. Cement-Mortar Interior Lining, Potable Water Piping: Pipe and fittings shall be furnished cement-lined and seal-coated in accordance with ANSI/AWWA Standard C104/A21.4, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.

5. Epoxy Lining, Interior, Sewage, Sludge, and Non-Potable Water Piping: For all non-potable water and wastewater pipe and fittings, the interior of ductile iron pipe and fittings shall be lined with an epoxy lining. The epoxy lining shall be Protecto 401 Ceramic Epoxy as manufactured by the Protecto Division of Vulcan Painters, Inc. All pipe and fittings shall be lined with a minimum dry film thickness of 40 mils, except for the gasket groove and spigot end up to six inches back from the end of the spigot which shall be lined with ten mils of the material. All ductile iron pipe and fittings shall be checked for dry film thickness in accordance with the SSPC-PA2. Each pipe joint and fitting shall be marked with the date of application of the lining system and with its numerical sequence of application on that date. The pipe supplier shall furnish a certificate stating that lining applicator has complied with all specification requirements relative to the material, its application and inspection. Surface preparation, number of coats, application of the lining material and field touch-up shall be in strict accordance with the lining material manufacturer's recommendations. During the installation of the pipe, the lining material manufacturer shall provide the services of a field engineer to instruct and demonstrate to the Contractor's personnel the procedure for the field touch-up of lining where field cuts and taps were required. Holiday inspection shall be conducted using test equipment described in American Water Works Association Standard, AWWA C210, Section 5.3.3.1. In accordance with coating manufacturer's recommendation, holiday testing may be conducted any time after the coating has reached sufficient cure.

6. Glass Lined, Interior, Grit Supply: New grit piping from point of connection to existing piping to the new grit washer inlet shall be glass lined, CF-58. Glass powder shall be vitreous and inorganic suitable for conveying grit sludge in sewage applications have the following physical and chemical properties:
    - ASTM D-792 test for density in the range of 2.5 to 3.0 grams per cubic centimeter.
    - Immersion testing using ASTM C-283-97 (2002) in a solution of 8% sulfuric acid at a temperature of 148 degrees F. (64 degrees C) for a period of 10 minutes minimum.
    - The glass shall have a minimum loss of surface gloss and a weight loss of no more than 2 milligrams per square inch (.31 mg per square centimeter).
    - Glass shall have no observed evidence of corrosion when exposed to an HCl solution of 3pH and separately to a NaOH solution of 10pH;

both elevated in temperature to 125 degrees F. (52 degrees C) for 10 minutes minimum.

- Glass shall be capable of withstanding an instantaneous thermal shock of 350 degrees F (176 degrees C) without cracking, crazing, blistering or spalling.
- Glass lining should have a minimum hardness of 6 on the MOHS scale.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Unless otherwise directed, ductile iron pipe shall be laid with the bell ends facing upstream in the normal direction of flow and in the direction of laying.

B. Restrained joints shall be made in accordance with the manufacturer's standards except as otherwise specified herein. Joints between restrained mechanical joint pipe and/or fittings shall be made in accordance with ANSI/AWWA Standard C600, except that deflection at joints shall not exceed 75 percent of the manufacturer's recommended allowable deflection, or 75 percent of the allowable deflection specified in ANSI/AWWA C600, whichever is the lesser amount.

C. Before laying restrained joint and restrained mechanical joint pipe and fittings, all lumps, blisters and excess bituminous coating shall be removed from the bell and spigot ends. The outside of each spigot and the inside of each bell shall be wire brushed and wiped clean and dry. The entire gasket groove area shall be free of bumps or any foreign matter which might displace the gasket. The cleaned spigot and gasket shall not be allowed to touch the trench walls or trench bottom at any time. Vegetable soap lubricant shall be applied in accordance with the pipe manufacturer's recommendations, to aid in making the joint. The workmen shall exercise caution to prevent damage to the gasket or the adherence of grease or particles of sand or dirt. Deflections shall only be made after the joint has been assembled.

D. Prior to making up flanged joints in ductile iron pipe and fittings, the back of each flange under the bolt heads and the face of each flange shall have all lumps, blisters and excess bituminous coating removed and shall be wire brushed and wiped clean and dry. Flange faces shall be kept clean and dry when making up the joint, and the workmen shall exercise caution to prevent damage to the gasket or the adherence of grease or particles of sand or dirt. Bolts and nuts shall be tightened by opposites in order to keep flange faces square with each other, and to insure that bolt stresses are evenly distributed.

E. Bolts and nuts in restrained joint, restrained mechanical joint and flanged joints shall be tightened in accordance with the recommendations of the pipe manufacturer for a leak-free joint. The mechanics shall exercise caution to prevent overstress. Torque wrenches shall be used until, in the opinion of the ENGINEER, the mechanics have become accustomed to the proper amount of pressure to apply on standard wrenches.

F. Cutting of the ductile iron pipe for inserting valves, fittings, etc., shall be done by the CONTRACTOR in a neat and workmanlike manner without damage to the pipe, the lining,

or the coating. Pipe 16 inches and larger in diameter shall be cut with a mechanical pipe saw. After cutting the pipe, the plain end shall be beveled with a heavy file or grinder to remove all sharp edges.

G. Areas of loose or damaged lining associated with field cutting shall be repaired or replaced as recommended by the pipe manufacturer and required by the ENGINEER. Repair methods shall be as recommended by the manufacturer and shall be submitted to the ENGINEER for review.

H. Any work within the pipe shall be performed with care to prevent damage to the lining. No cable, lifting arms or other devices shall be inserted into the pipe. All lifting, pulling or pushing mechanisms shall be applied to the exterior of the pipe barrel.

I. Homing the pipe shall be accomplished by the use of a hydraulic or mechanical pulling device, unless otherwise accepted by the ENGINEER. No pipe shall be driven or struck in order to seat it home.

J. Cleaning: Cleaning methods shall be acceptable to the ENGINEER, and must be sufficient to remove silt, rocks, or other debris which may have entered the pipeline during its installation and shall also follow the requirements of Section 15995 entitled “Pipeline Testing and Disinfection”.

- END OF SECTION -

SECTION 15008

PVC/CPVC PIPE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Reference Section 15000, Basic Mechanical Requirements.

PART 2 -- PRODUCTS

2.01 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. PVC pipe and fittings shall be manufactured in accordance with ASTM D 1785, D 1784 and F 441, "normal impact" pipe, Schedule 40 or 80 as specified.

B. Fittings used with this pipe shall be socket type or flanged type as specified herein, in Section 15390 - Schedules, or indicated on the Drawings. Plastic piping shall be installed in full accordance with the manufacturer's recommendations for the specific installation. No field bending or distortion of the pipe will be permitted.

C. PVC pipe shall be Type 1 Grade 1 conforming to ASTM D 1784 and D 1785. Fittings shall conform to the following standard specifications:

Socket Type (Schedule 40); ASTM D 2466
Socket Type (Schedule 80); ASTM D 2467

D. Provide flanged fittings of the same material as the specified pipe and material conforming to ANSI B16.5 at all valves and equipment except at true (double) union valves. Flange gaskets shall be natural rubber or other material fully compatible with the fluid being conveyed. Where flanged piping is used with chemical systems, the gasket material shall conform to the requirements of the following table. Flange bolts shall be type 316 stainless steel minimum, with higher grade materials used where necessary for fluid (chemical) compatibility.

Chemical	**Acceptable Gasket Material**
Ammonium Hydroxide	EPDM
Aluminum Sulfate	EPDM, Viton
Ammonium Sulfate	EPDM
Calcium Hypochlorite	Viton
Carbon Dioxide Solution	Viton
Chlorine Solution	Viton
Chlorine Dioxide Solution	Viton

Chemical	Acceptable Gasket Material
Ferric Chloride	EPDM, Viton
Ferric Sulfate	EPDM, Viton
Hydrochloric Acid	Viton
Hydrofluosilicic Acid	Viton
Lime Slurry	EPDM, Viton
Magnesium Chloride	EPDM, Viton
Magnesium Hydroxide	EPDM, Viton
Methanol	EPDM
Ozone Solution	Viton
Phosphoric Acid	Viton
Polyaluminum Chloride	EPDM, Viton
Polymer	Viton
Potassium Permanganate	EPDM
Powdered Activated Carbon Slurry	EPDM, Viton
Sodium Bisulfite	EPDM, Viton
Sodium Hydroxide (Caustic)	EPDM
Sodium Hypochlorite	Viton
Sodium Permanganate	Hypalon, Silicone, Aflas, Kalrez
Sodium Silicate	EPDM, Viton
Sodium Thiosulfate	EPDM, Viton
Sulfur Dioxide Solution	EPDM, Viton
Sulfuric Acid	Viton
Zinc Orthophosphate	EPDM, Viton

E. Solvent cement for socket type joints shall conform to ASTM D 2564 for PVC pipe and fittings. Solvent cement for chemical service shall be Weld-On 724 as manufactured by IPS Corporation, or equal.

F. C900-Class 200 shall be in sizes between 4 inches and 12 inches and shall meet the requirements of AWWA C900 "Poly Vinyl Chloride (PVC) Pressure Pipe" and shall conform to all the requirements of ASTM D1784 and ASTM D2241. The pipe shall be a minimum of DR 14 and shall be capable of withstanding the overburden pressures determined by the depth of burial in the field.

1. Pipe material shall be made from clean, virgin, NSF approved Class 12454-A PVC compound conforming to resin specification ASTM D1784. Standard laying lengths shall be 20-feet (±1 inch). Random lengths of not more than 15% of the total footage of each size may be shipped in lieu of the standard lengths. Reruns of reclaimed material shall not be accepted.

2. The pipe shall have bell and spigot ends with push-on, O-ring rubber gasket, compression type joints conforming to the requirements of ASTM 2672. Elastomeric

gaskets shall conform to the requirements of ASTM F477.

3. Minimum pipe stiffness (F/dY) at 5% deflection shall be 914 psi for all sizes when tested in accordance with D2241.

4. The pipe shall be designed to pass a quick burst test pressure of 985 psi applied in 60 to 70 seconds when tested in accordance with ASTM D1599, as referenced in ASTM D2241.

5. Fittings for C900-Class 200, DR 14 shall be ductile iron, bolted mechanical joint.

G. C900-Class 150 shall be in sizes between 4 inches and 12 inches and shall meet the requirements of AWWA C900 "Poly Vinyl Chlorine (PVC) Pressure Pipe" and shall conform to all the requirements of ASTM D1784 and ASTM D2241. The pipe shall be a minimum of DR 18 and shall be capable of withstanding the overburden pressures determined by the depth of burial in the field.

1. Pipe material shall be made from clean, virgin, NSF approved Class 12454-A PVC compound conforming to resin specification ASTM D1784. Standard laying lengths shall be 20-feet (±1 inch). Random lengths of not more than 15% of the total footage of each size may be shipped in lieu of the standard lengths. Reruns of reclaimed material shall not be accepted.

2. The pipe shall have bell and spigot ends with push-on, O-ring rubber gasket, compression type joints conforming to the requirements of ASTM 2677. Elastomeric gaskets shall conform to the requirements of ASTM F477.

3. Minimum pipe stiffness (F/dY) at 5% deflection shall be 435 psi for all sizes when tested in accordance with D2241.

4. The pipe shall be designed to pass a quick burst test pressure of 755 psi applied in 60 to 70 seconds when tested in accordance with ASTM D1599, as referenced in ASTM D2241.

5. Fittings for C900-Class 150, DR 18 shall be ductile iron, bolted mechanical joint.

H. PVC pressure rated pipe (PR 160) shall be in sizes between 1 1/2 inches and 12 inches and shall conform to all the requirements of ASTM D1784 and ASTM D2241 and shall be a minimum of SDR 26 and shall be capable of withstanding the overburden pressures determined by the depth of burial in the field.

1. Pipe material shall be made from clean, virgin, NSF approved Class 12454-A PVC compound conforming to resin specification ASTM D1784. Standard laying lengths shall be 20-feet (1± inch). Random lengths of not more than 15% of the total footage of each size may be shipped in lieu of the standard lengths. Reruns of reclaimed materials shall not be accepted.

2. The pipe shall have bell and spigot ends with push-on, O-ring rubber gasket, compression type joints conforming to the requirements of ASTM 2672. Elastomeric

gaskets shall conform to the requirements of ASTM F477.

3. Minimum pipe stiffness (F/dY) at 5% deflection shall be 135 psi for all sizes when tested in accordance with ASTM D2241.

4. The pipe shall be designed to pass a quick burst test pressure of 500 psi applied in 60 to 70 seconds when tested in accordance with ASTM D1599, as referenced in ASTM D2241.

5. The pipe shall be designed to pass for 1000 hours a sustained test pressure of 340 psi when tested in accordance with ASTM D1598, as referenced in ASTM D2241.

I. Fittings for PR 160, SDR 26 shall be PVC and designed for the pipe being supplied.

J. Acrylonitrile-butadiene-styrene (ABS) shall conform to the requirements of ASTM D 2661. Pipe and fittings shall have socket type couplings with solvent cement joints. Solvent cement shall conform to ASTM D 2235.

K. Type PSM polyvinyl chloride (PVC) pipe and fittings shall conform to the requirements of ASTM D 3034 with a maximum SDR of 35. Pipe and fittings shall have bell and spigot ends with O-ring rubber gasketed, compression type joints. Joints shall conform to the requirements of ASTM Specification D 3212. Reruns of reclaimed materials shall not be accepted. Unless indicated otherwise, PVC wall pipes shall be provided for all piping passing through exterior walls. Wall pipes shall have a water stop solvent-welded to the pipe. Each wall pipe shall be of the same class and type as the piping to which it is joined.

L. Perforated and closed drainage pipe and fittings shall be rigid PVC pipe, Schedule 40 unless otherwise shown or specified with solvent welded type joints, or approved equal. Pipe shall be slotted or have two rows of 1/4-inch diameter holes spaced 4-inches apart along the circumference of the pipe. Longitudinal spacing of holes shall be 5-inches maximum.

2.02 CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPE AND FITTINGS

A. CPVC shall be manufactured in accordance with ASTM D 1785, D 1784 and F 441, "normal impact" pipe, Schedule 40 or 80 as specified.

B. Fittings used with this pipe shall be socket type or flanged type as specified herein or indicated on the Drawings. Plastic piping shall be installed in full accordance with the manufacturer's recommendations for the specific installation. No field bending or distortion of the pipe will be permitted.

C. CPVC pipe shall be Type 4, Grade 1, Schedule 80, conforming to ASTM D 1784 and ASTM F 441. CPVC fittings shall be socket type conforming to ASTM F 439.

D. Solvent cement for socket type joints shall conform to ASTM F 493 for CPVC pipe and fittings. Solvent cement for chemical service shall be Weld-On 724 as manufactured by IPS Corporation, or equal.

- END OF SECTION -

SECTION 15012

STAINLESS STEEL PIPE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Stainless steel pipe and fittings shall conform to ASTM-A778 and ASTM A774, or ASTM A312 and ASTM A403, for nominal pipe sizes 1/4-inch and larger. Stainless steel pipe shall be new and shall meet or exceed the manufacturer and material requirements of ASTM A240.

B. All parts of the materials furnished shall be amply designed, manufactured and constructed for the maximum stresses occurring during fabrication and erection. All materials shall be new and both workmanship and materials shall be of the very best quality, entirely suitable for the service to which they will be subjected and shall conform to all applicable sections of these Specifications. Manufacturer's designs shall accommodate all the requirements of these Specifications.

C. Reference Section 15000 entitled "Piping, General".

PART 2 -- PRODUCTS

2.01 STAINLESS STEEL PIPE AND FITTINGS (PROCESS AIR)

A. Stainless steel piping for process air piping of nominal sizes ranging from three (3) inches to sixty (60) inches shall be manufactured from ASTM A240 annealed and pickled sheets and plates and fabricated in accordance with ASTM A778, or ASTM A312, in Type 304L stainless steel. Only stainless steel pipe shall be provided; tubing shall not be allowed. Stainless steel pipe, at a minimum, shall be service rated for 300°F at 25 psig. Stainless steel pipe shall be as manufactured by Douglas Brothers, Felker Bros. Corp., or equal.

B. The following information shall be provided:

1. An affidavit of compliance is required from the pipe manufacturers.

2. The steel manufacturer's certification that the material meets the ASTM specification will be accepted in lieu of tests on specimens taken from fabricated pipe.

3. The fabricator may purchase steel plates on the chemical basis only, and shall furnish to the Owner certified test reports.

4. Only seamless or one (1) longitudinal seam shall be permitted unless otherwise required for fabrication of large diameter pipe in accordance with ASTM A774 or ASTM A403.

5. Joints in piping 3-inches in diameter or larger shall be butt welded or flanged, unless otherwise shown on the Drawings. Joints in piping less than 3-inch diameter shall be threaded, unless otherwise shown on the Drawings.

C. Fittings shall be fabricated from the pipe specified and shall conform to ASTM A774, or ASTM A403, unless otherwise shown on the Drawings or required for proper installation.

D. Flanges where shown on the Drawings shall be a lap joint flange assembly consisting of a 304L stainless steel slip-on rolled angle ring with a 304L stainless steel drilled back up flange conforming to ASTM A240, and shall conform dimensionally conforming to ANSI B16.1, Class 125. Hardware shall be stainless steel per ANSI B18.2, type and grade to prevent galling. The angle of leg shall not interfere with the flange bolt holes. Alternately, slip-on plate flanges conforming to ANSI B16.1, Class 125 are acceptable at specific locations as approved by the Engineer. The plate flange shall be continuously welded to the pipe.

E. Bolts and Nuts: Provide hexagonal head and bolts and nuts. Size and length in accordance with the "American Standard" and comply with the requirements of the ANSI/AWWA Standards. The bolts for flanged joints shall be per ANSI B 18.2, stainless steel, type and grade to prevent galling. No washers shall be used.

F. The back-up flanges and plate flanges shall be supplied with the following nominal thicknesses.

Nom. Pipe Size (in.)	Flange Thickness (in.)
2-1/2 - 3	½
4	9/16
6 - 10	5/8

G. Gaskets for process air, all gaskets shall be 1/8-inch minimum thickness and shall be of a material suitable for 300°F continuous service at 25 psig. Dielectric gasket material service rated for 300°F continuous service at 25 psig shall be provided at all transitions to material other than mild steel.

H. Welding practices for joints shall conform to those specified for the manufacture of the pipe and fittings in ASTM A774 and A778, or ASTM A312 and ASTM A403, and the specifications contained herein. All welds shall be free from burrs, snags or rough projections.

I. Welding shall be performed by AWS certified welders in conformance with standard procedures. Piping with wall thickness up to 11 gauge (0.125") shall be welded with the TIG (GTAW) process. Heavier walls shall be properly beveled and have a root pass with the TIG (GTAW) process followed by subsequent passes with the TIG (GTAW), MIG (GMAW), or Metallic Arc (SMAW) process. Filler wire of ELC grades only shall be added to all welds to provide a cross section at the weld equal to or greater than the parent metal. Weld deposit shall be greater than the parent metal. Weld deposit shall be smooth and evenly distributed and have a crown of no more than 1/16 inch on the I.D. and 3/32 inch on the O.D. of the piping or fittings. Concavity, undercut, cracks or crevices shall not be allowed. Butt-welds shall have full penetration to the interior surface, and inert gas

shielding shall be provided to the interior and exterior of the joint. Excessive weld deposits, slag, spatter and projections shall be removed by grinding. Angle face rings shall be continuously welded on both sides to the pipe or fitting. Welds on gasket surfaces shall be ground smooth.

J. All fittings shall be welded with 304L filler metal. All elbows through 24 inch size shall be long radius, die formed and shall be automatically butt welded in accordance with ASTM A774, or ASTM A403, of the same material and thickness as the pipe, using gas tungsten-arc procedures with inert gas backing. Tees, crosses, true Y's and laterals shall be shop fabricated. All reducers shall be straight tapered, cone type. Longitudinal welds on all fittings, except elbows, shall be accomplished by the same procedures as listed for pipe. Weld seams shall have full penetration and be free of oxidation, crevices, pits, cracks and protrusions. Fitting dimensions shall be in accordance with ANSI B16.9, and shall be terminated and dimensioned as indicated on the Drawings.

K. Pipe spools shall be manually welded with 304L filler metal, using gas tungsten-arc procedures with internal gas purge where internal weld seams are not accessible. Where they are accessible, seams shall be welded both inside and outside, using manual shielded metal-arc procedures. Weld seams shall have full penetration and be free of oxidation, crevices, pits, cracks and protrusions.

L. All pipe, fittings and spools shall be completely pickled and passivated by immersion in a nitric-hydrofluoric bath at the proper temperature and length of time to insure removal of all free iron, weld scale and other impurities and to insure the establishment of a passive surface. A clean water rinse shall follow the acid pickle.

M. The field testing procedure for process air piping shall use air pressure only.

N. The inspection of all welds shall be required. This shall be a visual inspection for crevices, pits, cracks, protrusions and oxidation deposits. Presence of any of these items found in the weld seams shall be considered as grounds for rejection of the joint.

O. All fabricated piping shall have openings plugged and flanges secured for storage and/or transport after fabrication. All fabricated piping shall be piece marked with identifying numbers or codes which correspond to the Contractor's layout and installation drawings. The marks shall be located on the spools at opposite ends and 180 degrees apart.

P. The piping supplier during manufacturing, fabrication and handling stages, and the Contractor during handling and installation stages, shall use extreme care to avoid the contact of any ferrous materials with the stainless steel piping. Only manufacturer recommended saws, drills, files, wire brushes, etc. shall be used for stainless steel piping. Pipe storage and fabrication racks shall be non-ferrous or stainless steel or rubber lined. Nylon slings or straps shall be used for handling stainless steel piping. Contact with ferrous items may cause rusting of iron particles embedded in the piping walls. After installation, the Contractor shall wash and rinse all foreign matter from the piping surface. If rusting of embedded iron occurs, the Contractor shall pickle the affected surface with Oakite Deoxidizer SS or equal, scrub with stainless steel brushes and rinse clean.

Q. Process air pipe shall be manufactured to nominal pipe sizes as listed in ANSI B36.19, Table 2, and shall have the following minimum wall thicknesses: Schedule 10S

R. All parts of the materials furnished shall be amply designed, manufactured and constructed for the maximum stresses occurring during fabrication and erection. All materials shall be new and both workmanship and materials shall be of the very best quality, entirely suitable for the service to which they will be subjected and shall conform to all applicable sections of these Specifications. Manufacturer's designs shall accommodate all the requirements of these Specifications.

S. The Contractor shall be responsible for the structural design of the stainless steel pipe, fittings and couplers. The Contractor shall submit certification that the stainless steel pipe, fittings and couplers have been designed to resist all loads implied and reasonably anticipated.

PART 3 -- EXECUTION

3.01 PRESSURE TESTING

A. Perform pressure testing for leakage in accordance with requirements of section 15995, “Pipeline Testing”.

- END OF SECTION -

SECTION 15020

PIPE SUPPORTS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all equipment, labor, materials, and design calculations required to provide pipe supports in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01350 – Seismic Anchorage and Bracing

B. Division 3, Concrete – Appropriate and Related Sections

C. Section 05010 – Metal Materials

D. Section 05035 – Galvanizing

E. Section 05050 – Metal Fastening

F. Section 05061 – Stainless Steel

G. Section 05120 – Structural Steel

H. Section 05500 – Metal Fabrications

I. Section 05830 – Bearing Devices and Anchoring

J. Section 15000 – Basic Mechanical Requirements

1.02 SUBMITTALS

A. Applicable and associated cut sheets and drawings for materials and support components shall be submitted with the Shop Drawings in accordance with or in addition to the submittal requirements specified in Section 01300 – Submittals: Section 15000 - Basic Mechanical Requirements and other referenced Sections above.

1. Catalog cut information on all system components such as pipe supports, hangers, guides, anchors, and channel-type supports.

2. Drawings of the piping support systems, locating each support, brace, hanger, guide, component and anchor. Identify support, hanger, guide and anchor type by catalog number and Shop Drawing detail number.

3. With each piping support system Shop Drawing, the Contractor shall attach calculations prepared and sealed by a Professional Engineer licensed in the State of Florida showing that the piping support system complies with the specified requirements, including all building code and seismic code requirements pertaining to support of piping and other non-structural components. See Section 01350 – Seismic Anchorage and Bracing.

4. Table showing the manufacturer's recommended hanger support spacing for PVC, CPVC and FRP pipe for the services listed in Section 15008 - Schedules.

1.03 QUALITY ASSURANCE

A. Piping support systems shall be designed and Shop Drawings prepared and sealed by a Professional Engineer licensed in the State of Florida.

PART 2 – PRODUCTS

2.01 GENERAL

A. The Contractor shall be responsible for the design of all piping support systems not specifically designed by the Engineer and detailed on the Drawings. The supports typically detailed on the Drawings, not included on Standard Detail Drawings, are designed to resist resulting external thrust forces in addition to gravity, seismic and other applicable loads required by the governing building code.

B. No attempt has been made to show all of the required pipe supports either on the main Drawings or on the standard detail drawings. The absence of pipe supports and details on the Drawings shall not relieve the Contractor of the responsibility of providing them throughout the project at no additional cost to the County.

C. Where special pipe support fabrications are required, products and execution shall be as specified in Section 05500 - Metal Fabrications and other related and referenced Sections of the Specifications. .

D. Existing piping support systems to support new piping shall only be used if the Contractor can show and demonstrate by submitting supporting calculations that they are adequate for the additional load imposed by the new piping, or if they are strengthened to support the additional load.

E. Design Criteria for Piping Support Systems:

1. Design pipe supports for dead loads imposed by the weight of the pipes filled with water, except for air and gas pipelines, plus the weight of insulation. If applicable by location, ice loads per code shall be applied as indicated in the governing building code.

2. Design for the thermal expansion and contraction of the piping and its associated pipe support and pipe expansion systems and couplers.

3. Design the pipe supports for all seismic loading requirements and conditions as specified in the governing building code and referenced seismic design codes. Refer to Section 01350 - Seismic Anchorage and Bracing and the structural code drawing for seismic design criteria to be used for this particular project.

4. A minimum safety factor of 2 or as approved by the Engineer, based upon the yield strength of the support material, shall be used for pipe supports, braces, hangers, and guides as well as for beam and column members used in channel-type support systems.

5. The horizontal pipe hanger and/or floor support spacing shall be as recommended by the pipe and/or hanger manufacturer, but shall not exceed 10 feet on center unless indicated otherwise herein or on the Drawings.

6. Seismic and sway bracing shall be provided at maximum 10-foot centers.

7. The design, sizing and spacing of anchor bolts, including concrete anchors, shall be based on withstanding shear and pullout loads imposed by loading at each particular support. The minimum anchor bolt size shall be ½ inches in diameter. Refer to Section 05830 – Bearing Devices and Anchoring.

2.02 HANGERS AND SUPPORTS

A. All piping shall be adequately supported and braced by means of steel hangers and/or supports, concrete piers, supplemental lateral bracing components, pre-fabricated brackets, or otherwise as may be required by the location and forces applied per governing code, including gravity and lateral forces from earthquake and/or wind (if exterior). Generally, concrete supports shall be used where pipe centerline is less than 3 feet above floor, and hangers above 6 feet unless specified or shown otherwise. Supports shall be not more than 10 feet on center for steel and cast iron, 5 feet on center for plastic unless otherwise shown on the Drawings or required by the specific manufacturer. All necessary inserts or appurtenances shall be furnished and installed in the concrete or structures for adequately securing hangers and supports to the structure. Refer to Standard Detail Drawings.

1. Metal pipe support materials, where stainless steel pipe is supported, shall be Type 304 stainless steel meeting the requirements of Section 05061 - Stainless Steel.

2. Metal pipe support materials, where carbon steel, ductile or other ferrous pipe is supported, shall be galvanized carbon steel meeting Section 05120 - Structural Steel and Section 05035 - Galvanizing unless indicated otherwise on the Drawings or in the specifications or by the Engineer.

3. Metal pipe supports indicated as standard type pipe hangers are designed and detailed for gravity loading only. Resulting lateral loads from wind, earthquake, or other lateral loads per code, or special loading conditions during construction, shall be applied to the pipe in accordance with the governing building code. Supplemental lateral stiffening members (when necessary) shall be provided along pipe or at gravity supports using appropriate supplemental members and

connections when required by calculations. The Contractor shall include design calculations and details with all pipe hangar and support submissions for review by the Engineer. The main structure and structural components that will support the pipe hangers and other appurtenant components of the facility have been designed to resist all resulting secondary lateral loading from pipe hangers and other non-structural members for gravity and resulting lateral loads.

B. Hangers and supports shall conform to the following requirements:

1. All fabricated metal hangers and supports shall be capable of adjustment after installation. Different types of hangers and supports along a pipe length, including bends, shall be kept to a minimum.

2. Hanger rods shall be straight and vertical. Chain, wire, strap, or perforated bar hangers shall not be used. Hangers shall not be suspended from other piping.

3. Vertical piping shall be properly supported at each floor and between floors by stays or braces to prevent rattling and vibration.

4. Supports and hangers for plastic and FRP piping shall include wide saddles or bands as recommended by the manufacturer and approved by the Engineer to distribute load and thus avoid localized deformation of the pipe.

5. Hanger and supports shall prevent contact between dissimilar metals by use of copper plated, rubber, vinyl coated or stainless steel hangers.

6. Ferrous pipes to be painted shall be painted in accordance with Section 09900 - Painting. Ferrous pipes that require painting or galvanizing shall be supported by galvanized hangers and supports. Stainless steel piping shall be supported by stainless steel saddles and straps (if required).

7. Copper piping shall be supported by plastic coated or copper plated steel hangers and supports.

8. Plastic piping shall be supported by plastic coated steel hangers and supports.

9. Hangers and supports shall provide for thermal expansion throughout the full operating temperature range.

10. Expansion and adhesive type anchors used for pipe hangers and supports shall be Type 304 stainless steel.

C. Metallic hangers and supports may be standard make by Anvil International, Inc., "Witch" by Carpenter & Paterson, Ltd., B-Line Systems, Inc., or equal; and data on the types and sizes to be used shall be furnished to the Engineer for approval. Metallic support system brackets, rods, support clips, clevis hangers, hardware, etc. shall be cast iron or welded steel construction. All gravity type hangers and supports shall be restrained laterally to resist seismic loading and other loading as required by the governing code.

D. Non-metallic support system shall be a heavy duty channel framing system. Channel frames shall be manufactured by the pultrusion process using corrosion grade polyester or vinylester resins. All fiberglass construction shall include suitable ultraviolet inhibitors for UV exposure and shall have a flame spread rating of 25 or less per ASTM E84. Piping accessories, pipe clamps, clevis hangers, support posts, support racks, fasteners, etc., shall be constructed of vinylester or polyurethane resin. Non-metallic support systems shall be standard make Aickinstrut by Aickinstrut, Inc., Unistrut Fiberglass by Unistrut, Inc., Enduro Fiberglass Systems, or equal. The Contractor shall submit data on the types and sizes of approval. Unless otherwise shown or specified the Contractor shall provide support spacings in the conformance with the pipe and support system manufacturer's requirements.

2.03 PROCESS AIR PIPE SUPPORTS

A. Unless specifically designed and detailed on the Drawings, process air piping shall be supported by slide bearings as manufactured by Fluorocarbon Company, Anaheim, California, Anvil International, Inc., Portsmouth, New Hampshire, or equal. Refer to Section 05830 – Bearing Devices and Anchoring for supplemental information and requirements.

B. The slide bearing material shall be 3/32 inch thick, 25 percent glass-fiber reinforced structural grade teflon. The bearing material shall withstand at least 1000 psi (compression) at 250□F with a coefficient of friction between .05 and.08. The performance of bearing and bonding materials shall be unaffected by continual immersion in wastewater containing domestic and industrial waste at a temperature of 210□F.

C. Non-submerged slide bearing type supports shall be provided with a bearing material covering a 120□ arc centered at the bottom of the pipe. The Teflon shall be at least 4 inches wide at the underside of the pipe and 8 inches wide at the top of the support. The Teflon material shall be hot press bonded to 10 ga. stainless steel plates for welding to the bottom of the pipe and securing to the top of the support.

D. Submerged slide bearing type supports shall be provided with Teflon bonded to the underside of the hold down strap and the top of the pipe such that the sliding surface is formed between two sheets of Teflon. Each surface shall cover a 120□ arc centered at the top of the pipe. On the underside of the strap the Teflon bearing shall be hot press bonded directly to the stainless steel strap or to a 10 ga. stainless steel plate for welding to the strap. At the top of the pipe, the Teflon shall be bonded to a 10 ga. stainless steel plate for welding to the pipe.

E. Pipe straps shall not tightly bind the pipe but shall provide 1/16 inch clearance over the top 180□ of the pipe surface.

F. Wall bracket supports shall be used where shown for pipe to be installed adjacent to a wall. Where it is not feasible to install hanger supports, adjustable pipe saddle supports may be used with the permission of the Engineer. Concrete pier supports shall be spaced at a maximum distance of 10 feet and shall be at least 12” wider than O.D. of pipe and 10 inches thick unless otherwise shown on the Drawings. Refer to the Standard Detail Drawings.

G. Small diameter piping (6-inches in diameter or less) shall <u>not</u> be strapped or otherwise secured directly to walls. Suitable wall offset brackets of an approved type shall be used.

Anchors shall not be attached using percussion fasteners.

H. Sliding surfaces shall be protected from accumulation of dirt, grit, or other foreign matter.

I. Slide bearings shall be capable of adequately supporting the design loads and shall be attached to pipe and supports as specified and recommended by the manufacturer.

J. The slide bearings shall be installed in the locations shown or indicated on the Drawings, at required elevations, true to orientation and level, assuring that the correct half of each bearing is in its proper position. The Contractor shall store the bearings to protect them from mechanical damage prior to installation, and shall protect the same during and after installation from contamination and damage due to placing of concrete and other materials. The Contractor shall clean the operating surfaces of bearings thoroughly before final assembly.

K. The Contractor shall note that all pipe support locations are not shown on the Drawings and shall follow the Specifications herein in locating supports. Where deviations and modifications are required, they shall be made only with the permission of the Engineer. A detailed layout of pipe supports and hangers shall be submitted for approval.

PART 3 -- EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Support piping connections to equipment by pipe support and not by the equipment.

B. Support large or heavy valves, fittings, flow meters and appurtenances independently of the connected piping.

C. Support no pipe from the pipe above it.

D. Support piping at changes in direction or in elevation, adjacent to flexible joints, expansion joints, and couplings, and where shown.

E. The Contractor shall not install piping supports and hangers in equipment access areas or bridge crane runs.

F. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing.

G. Install pipe anchors (fixed supports and/or guides) where shown and/or as may otherwise be required to withstand expansion thrust loads and to direct and control thermal expansion. The Contractor may install additional pipe anchors and flexible couplings to facilitate piping installation, provided that complete details describing location, pipe supports and hydraulic thrust protection are submitted.

- END OF SECTION -

SECTION 15030

PIPING, VALVE, AND EQUIPMENT IDENTIFICATION SYSTEMS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install all components of the system for identification of piping and equipment as specified hereinafter. The system shall include the application of color coding to all new and altered plant piping. The Contractor shall paint the equipment and piping of all Contracts in the colors herein specified, and in accordance with the requirements of Section 09900, Painting.

1.02 SUBMITTALS

A. Submit shop drawings and manufacturer's product literature in accordance with Section 01300 entitled "Submittals". Submit with the shop drawings, a schedule of the colors and designations proposed for each service. A minimum of four (4) color charts with cross-references to the colors and services listed herein shall be included with the submittal. The OWNER shall select the final color for each service during shop drawing review.

B. Submit manufacturer's descriptive literature, illustrations, specifications and other pertinent data.

C. Schedules:

1. Provide a complete list of all piping to be color coded, identified by service, and flow direction indicated noting the color of pipe and bands, lettering to be used, and height and color of lettering and flow arrows.

2. Provide a complete list of all valves to be identified listing valve description and the proposed inscription on the valve tag.

2. Provide a complete list of materials to be furnished and surfaces on which they will be used.

PART 2 -- PRODUCTS

2.01 PIPING IDENTIFICATION LETTERING AND ARROWS

A. The CONTRACTOR shall apply identification lettering, in the form of plain upper-case block lettering, giving the name of the pipe contents and arrows indicating the direction of flow to all types and sections of piping.

B. All lettering and arrows shall be of the vinyl, self-adhesive tape type or the plastic snap-on/strap-on type with self gripping fasteners. Pipe marking devices (i.e., tape or snap-on/strap-on type) shall be suitable for a 5 to 8-year outdoor life without discoloration. Pipe

marking devices shall be as manufactured by Seton custom pipe markers, Brady pipe markings, or approved equal. Alternately, lettering and arrows may be formed by stenciling in an approved manner using white or black paint compatible with the pipe coating specified in Section 09900. Lettering height in inches shall be as follows:

Diameter of Pipe or Pipe Covering	Height of Lettering
3/4 to 1-1/4 inches	1/2-inches
1-1/2 to 2-inches	3/4-inches
2-1/2 to 6-inches	1-1/4-inches
8 to 10-inches	2-1/2-inches
Over 10-inches	3-1/2-inches

C. Identification lettering and arrows shall be placed as directed by the ENGINEER, but shall generally be located every ten (10) feet and shall be properly inclined to the pipe axis to facilitate easy reading. Lettering shall also appear directly adjacent to each side of any wall or slab the pipeline passes through, with a minimum of two (2) titles on each pipe in one structure.

D. The manufacturer's instructions shall be followed in respect to storage, surface preparation and application.

E. Pipe lettering for each service type shall be as indicated below for flow stream identification or as otherwise directed during shop drawing review:

Service	Letting
Digested Sludge	DS
Reclaimed Water	RCW
Polymer	POLY
Drain	DRAIN
Vent	VENT
Supply Air	AIR
Centrate	CEN
Hypochlorite	HYPO

2.02 STRUCTURE, PIPING, VALVE, AND EQUIPMENT COLOR CODING

A. Structure colors, equipment colors, piping and valve colors shall be as indicated in Table 15030-01 on the following page. The colors referenced in this table are Lee County's standard colors for the service indicated. The CONTRACTOR shall provide the colors selected by the OWNER during shop drawing review from the selected painting manufacturer's color charts to best match these standard colors.

Table 15030-1
Piping and Equipment Identification Schedule

Service Type	Lettering / Arrow Color	Pipe Color	Bruning Color Ref.	Sample
Air	Black	Green	Green 532-27	
Reclaimed Water	Black	Light Blue	Wood Lights 60-6W	
Digested Sludge	White	Dark Brown	Acorn 532-36	
Potable Water	White	Blue	Blue 532-34	
Centrate	Black	Light Grey	Cruiser Gray 532-31	
Hypochlorite	Black	White	White 532-00	
Polymer	White	Purple		
Motors, Gear Box	-----	Light Grey	Cruiser Gray 532-31	
Coupling Guards	-----	Yellow	Yellow 532-35	
Structure Exteriors	-----	Light Beige	Match Existing	
Interior of Rooms	-----	Beige	Hacienda T144-4	
Vents	Black	Light Grey	Cruiser Gray 532-31	
Drains	Black	Light Grey	Cruiser Gray 532-31	
Structure Trim	----	Brown	Walnut Grove T127-8	

2.03 BELOW GROUND PIPING IDENTIFICATION

A. Identification Tape: Buried piping and conduit on the site shall be identified by identification tape installed over the centerline of the pipelines.

1. Identification Tape for Steel or Iron Pipe and Conduit: Identification tape shall be manufactured of inert plastic film so as to be highly resistant to alkalies, acids, or other destructive agents found in soil, and shall have a minimum thickness of 4 mils. Tape width shall be 6 inches and shall have background color specified below, imprinted with black letters. Imprint shall be as specified below and shall

repeat itself a minimum of once every 2 feet for entire length of tape. Tape shall be Terra Tape Standard 250, or approved equal.

2. Identification Tape for Plastic or Non-Magnetic Pipe and Conduit: Identification tape shall be manufactured of reinforced inert plastic film with a minimum overall thickness of 9.7-mils and shall have a 0.5-mil thick magnetic metallic foil core. The tape shall be highly resistant to alkalies, acids, and other destructive agents found in soil. Tape width shall be 3 inches and shall have background color specified below, imprinted with black letters. Imprint shall be as specified below and shall repeat itself a minimum of once every 2 feet for entire length of tape.

3. Tape background colors and imprints shall be as follows:

Imprint	Pipe Service	Background Color
"Caution - Water Line Buried Below"	PW	Blue
"Caution - Sewer Line Buried Below"	FM	Green
“Caution - Reclaimed Line Buried Below”	RW	Purple
"Caution - Electrical Line Buried Below"	----	Red

4. Identification tape shall be "Terra Tape" as manufactured by Reef Industries, Inc., Houston, TX, (800) 231-6074; Allen Systems, Inc., Wheaton, IL (800) 323-1749; or approved equal.

2.04 VALVE IDENTIFICATION

C. Aboveground Valve Identifications: On all valves used to change direction of flow or isolation valves not immediately adjacent to isolated equipment, provide an engraved tag attached with a stainless steel or brass chain or "S" hook.

1. Tag Types: Tags for valves on pipe shall be brass or anodized aluminum. Tags shall be round.

2. Coding: Each tag shall be stamped or engraved to describe the valve service. Submit list of proposed tags and engravings for approval prior to ordering.

D. Buried valves shall have valve boxes protected by a concrete pad. The concrete pad for the valve box cover shall have a 2 1/2-inch diameter, bronze disc embedded in the surface as shown on the Drawings. The bronze disc shall have the size of valve in inches, the type of valve (GV - Gate Valve, BFV - Butterfly Valve, PV - Plug Valve), the valve service (determined by flow stream identification code as listed on the Drawings), the number of turns to fully open the valve, the direction of turn to open the valve (CW for clockwise, CCW for counter-clockwise), and year of installation neatly stamped on it.

PART 3 - EXECUTION

3.01 INSTALLATION OF IDENTIFICATION TAPE

A. Identification tape shall be installed for all buried water, chemical, and electrical conduit lines in accordance with the manufacturer's installation instructions and as specified herein.

B. Identification tape shall be installed 18 inches below final grade over centerline of pipe.

3.02 BURIED VALVES

A. In paved or concrete areas, tops of valve box covers shall be set flush with pavement or concrete top. In concrete areas, valve boxes shall be embedded. Following paving operations, a 24-inch square shall be neatly cut in the pavement around the box and the paving removed. The top of the box shall then be adjusted to the proper elevation and a 24-inch square by 6-inch thick concrete pad poured around the box cover. Concrete pads in traffic areas shall be reinforced with No. 4 reinforcement bars as shown on the Drawings. Concrete for the pad shall be 3,000 psi compressive strength.

B. In unpaved areas, tops of valve box covers shall be set 0.20-foot above finished grade. After the top of the box is set to the proper elevation, a 24-inch square by 6-inch thick concrete pad shall be poured around the box cover. Concrete for the pad shall be 3,000 psi compressive strength.

C. The bronze, valve identification disc shall be embedded in the concrete pad while concrete is still pliable.

- END OF SECTION -

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SECTION 15085

CHEMICAL TUBING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. This section includes materials and accessories for plastic tubing for chemical service.

1. Heavy Duty Food Grade Reinforced PVC Tubing shall be used for sodium hypochlorite solution service.

1.02 SUBMITTALS

A. Submit shop drawings in accordance with the General Conditions, Section 01300 and the following.

B. Submit manufacturer's catalog data and descriptive literature for tubing, and couplings. Show pressure rating and materials of construction for tube, carcass, and cover. Show design of tubing ends.

C. Submit procedures for making up insert fittings and joints and compression fittings and joints.

PART 2 -- PRODUCTS

2.01 CHEMICAL TUBING

A. Heavy Duty Food Grade Reinforced PVC Tubing

1. Provide tube consisting of a clear PVC inner tube with synthetic yarn reinforcing and a white or gray PVC cover. Tube shall be certified for potable water service per NSF 61. Minimum operating pressures shall be 150 psi for 3/4 inch tubing. Joints and fittings shall be of the barb insert-type hose fittings with 316 stainless steel clamps.

2. Products: Kuri-Tec Clearbraid K3130 Series BF, Ryan-Herco “Herco Braid Food Grade Tubind, Heavy Duty”, New Age Industries Nylobrade, or equal.

3. Products: Parker Hannifin Polypropylene Tubing Series PP, Ryan Herco “Herco-Pro Polypropylene Tubing”, or equal.

B. Insert Fittings

1. Insert fitting shall be as recommended by the tubing manufacturer for the service conditions and shall be compatible with the sodium hypochlorite. The completed tubing and fitting system shall have the same operating pressure ratings as specified for the tubing.

C. Quantities

1. Provide chemical tubing in continuous lengths between handholes in the yard. No joints or connections shall be permitted between handholes. Furnish chemical tubing in rolls and field cut to the lengths required.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Install chemical tubing in continuous lengths between handholes in the yard. Make joints or connections inside handholes, and only if necessary. Secure tubing inside handholes using FRP channel type pipe supports but do not clamp down tightly on the tubing. Support tubing such that it can slide to allow for expansion and contraction. Coil tubing inside each handhole to allow for expansion and contraction. Coil radius shall be greater than the minimum allowable radius provided by the manufacturer or in accordance with the tubing manufacturer's instructions.

3.02 HYDROSTATIC TESTING

1. Hydrostatically test hose for leakage in accordance with Section 15995. Leakage shall be zero. Test pressure shall be 100 psig.

- END OF SECTION -

SECTION 15095

VALVES, GENERAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install, complete with all assemblies and accessories, all valves shown on the Drawings and specified herein including all fittings, appurtenances and transition pieces required for a complete and operable installation.

B. All valves shall be constructed of first quality materials which have strength, wearing, and corrosion resistance characteristics entirely suitable for the types of service for which the individual valves are designated. Except where noted otherwise, valves designated for water service shall conform to pertinent sections of the latest revision of AWWA C500 Specifications. Cast iron valve bodies and parts shall meet the requirements of the latest revision of ASTM Designation A-126, "Standard Specifications for Gray Iron Castings for Valves, Flanges, and Pipe Fittings, Class B."

C. All valve body castings shall be clean, sound, and without defects of any kind. No plugging, welding, or repairing of defects will be allowed.

D. Valves shall have flanged ends for exposed service and mechanical joint ends for buried service, unless otherwise shown on the Drawings or specified herein. Flanged ends shall be flat-faced, 125 lb. American Standard unless otherwise shown or specified in accordance with ANSI B16.1. All bolt heads and nuts shall be hexagonal of American Standard size. The Contractor shall be responsible for coordinating connecting piping. Valves with screwed ends shall be made tight with Teflon tape. Unions are required at all screwed joint valves.

1.02 SUBMITTALS

A. The Contractor shall furnish to the County, through the Engineer, a Performance Affidavit where required in individual valve specifications, utilizing the format specified in Section 11000, Equipment General Provisions. Performance tests shall be conducted in accordance with the latest revision of AWWA C500 and affidavits shall conform to the requirements of the Specifications

B. Shop Drawings conforming to the requirements of Section 01300, Submittals, are required for all valves, and accessories. Submittals shall include all layout dimensions, size and materials of construction for all components, information on support and anchoring where necessary, pneumatic and hydraulic characteristics and complete descriptive information to demonstrate full compliance with the Documents. Shop Drawings for electrically operated/controlled valves shall include all details, notes, and diagrams which clearly identify required coordination with the electrical power supply and remote status and alarm indicating devices. Electrical control schematic diagrams shall be submitted with the Shop Drawings for all electrical controls. Diagrams shall be drawn using a ladder-type format in accordance

with JIC standards. Shop Drawings for pneumatically operated/controlled valves shall include all details, notes, and diagrams which clearly identify required coordination with the compressed air (service air) system and electrical controls.

C. Operation and maintenance manuals and installation instructions shall be submitted for all valves and accessories in accordance with the Specifications. The manufacturer(s) shall delete all information which does not apply to the equipment being furnished.

1.03 CONTRACTOR'S RESPONSIBILITIES

A. The Contractor shall provide the services of a qualified representative of the manufacturer(s) of the equipment named below to check out and certify the installation(s), to supervise the initial operation, and to instruct the County's operating personnel in proper operation and maintenance procedures in accordance with the following schedule:

Item	Valve/Operator Type	Minimum On-Site Time Requirements
1.	Automatic Control Check Valve	One (1) 8-hour day
2.	Surge Anticipators	One (1) 8-hour day
3.	Motor Operated Modulating Valves	One (1) 8-hour day
4.	Motor Operated Open-Close Valves (required only if manufacturer is other than for Item 3 above)	One (1) 8-hour day
5.	Pneumatic Hydraulic Cylinder Operated Valves	One (1) 8-hour day

B. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor. The manufacturer's representative shall sign in and out at the office of the Engineer's Resident Project Representative on each day he is at the project.

C. A written report covering the representative's findings and installation approval shall be mailed directly to the Engineer covering all inspection and outlining in detail any deficiencies notes.

D. The times specified are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.

PART 2 -- PRODUCTS

2.01 FLOW INDICATORS

A. Flow indicators shall be the Akron ball-type as manufactured by Brooks Instrument Co., Fischer and Porter, or equal, and shall have bronze bodies, glass dome, and plastic ball.

2.02 CORPORATION STOPS

A. Corporation stops shall be of bronze with tapered male iron pipe threads on inlets and outlets. Terminal outlets shall have screwed bronze hex head dust plugs or caps. Unions

shall be used on all corporation stop outlets with connecting piping. Corporation stops shall have a minimum working pressure rating of 250 psi and shall be as manufactured by Mueller Co., Hays Mfg. Div. of Zurn Industries, or equal.

2.03 FLOOR BOXES

A. Floor boxes shall be provided for all nut operated or floor accessed valves. Floor boxes shall be of the adjustable, sliding type, cast iron, suitable to withstand heavy traffic, as manufactured by James B. Clow & Sons, Kennedy Valve Mfg. Co., or equal. The covers shall be marked with appropriate designations of piping contents (i.e.: water, sewer) and bases shall be the round type. All nut operated valves in this Section shall be clearly identified by stainless steel or laminated plastic identification tags. The tags shall be permanently affixed to the inside of the floor boxes, under grating, etc. and shall bear the embossed letters which clearly identify each valve by its appropriate designation.

B. Two (2) valve operating wrenches shall be supplied in 4 foot lengths with tee handles for each size nut supplied. Valve wrenches shall be Model No. F-2520 as manufactured by James B. Clow & Sons, Kennedy Valve Mfg. Co., Figure No. 122, or equal.

2.04 VALVE BOXES

A. The Contractor shall furnish and install valve boxes as shown on the Drawings and specified herein.

B. All valve boxes shall be placed so as not to transmit shock or stress to the valve and shall be centered and plumb over the operating nut of the valve. The ground in the trench upon which the valve boxes rest shall be thoroughly compacted to prevent settlement. The boxes shall be fitted together securely and set so that the cover is flush with the finished grade of the adjacent surface. A concrete pad as detailed on the Drawings shall be provided around the valve box, sloped outwards.

C. All valve boxes shall be 2-piece cast iron, sliding type, 5-1/4" shaft, with heavy duty traffic weight collar and the lid marked with the appropriate carrier product (i.e.: WATER). Boxes shall be as manufactured by James B. Clow & Sons, Kennedy Valve Mfg. Co., Charlotte Pipe and Foundry Company, or equal.

2.05 STRAINERS

A. Y-Strainers shall be Y-pattern cast iron body, flanged or screwed ends with stainless steel or Monel, 20 mesh strainers. Strainers shall be 200 psi, cold-water service strainers, as manufactured by WATTS, Crane Co., Zurn, or equal.

B. Caustic service Y-strainers shall be provided as shown on the drawings. Strainers shall be full port-full flow design manufactured of 304 or 316 stainless steel body. Y-strainers shall be furnished with flanged ends. The strainer screen shall be 1/32-inch perforation, easily removable, manufactured of the same material as the valve body.

C. Stainless steel Y-strainers shall be provided as shown on the drawings. Strainers shall be full port-full flow design manufactured of 304 or 316 stainless steel body. Y-strainers shall

be furnished with flanged ends. The strainer screen shall be 1/32-inch perforation, easily removable, manufactured of the same material as the valve body.

D. PVC and CPVC y-strainers shall be provided in PVC and CPVC piping and as shown on the Drawings. Strainer shall be provided with PVC or CPVC body and end cap, EPDM or Viton seal as required for the chemical service, and 20 mesh screen. Temperature rating shall be 30°F to 140°F, and pressure rating shall be 150 psi @ 70°F, non-shock. PVC and CPVC y-Strainers shall be as manufactured by Asahi/America, Hayward, or equal.

E. Manually cleaned strainers shall be the duplex basket tapered plug type.

1. Strainers 3-inches in diameter and larger shall have flanged ends conforming to ANSI B16.1-125/150 pound standard.

2. Strainers less than 3-inches in diameter shall have screwed end connectors, unless otherwise shown on the Drawings.

3. Strainers shall be constructed with an ASTM A48, Class 30 cast iron body, ductile iron trim, removable 0.045 inch staggered hole perforation, 304 stainless steel filter baskets and gauges on the inlet and outlet.

4. All strainers shall be suitable for 125 psi service.

5. Switching flow from one basket to the other shall be accomplished by moving the handle through a 180□ arc. The switching operation shall not stop flow through the strainer and shall provide for on-line removal of either basket with the other basket functional. The plug shall be automatically positioned with integral stops and shall be easily lifted and reseated under pressure.

6. The strainer shall be designed to minimize the possibility of material bypassing the plug while being rotated and to prevent debris from building up under the plug. The strainer covers shall be designed for quick opening with swing away yoke.

7. Each basket compartment shall have a side drain outlet.

8. All strainers shall be provided with support legs.

9. Duplex basket strainers shall be similar to the Model 53BTX as manufactured by Hayward, or equal.

F. PVC and CPVC simplex basket strainers shall be provided in PVC and CPVC piping as shown on the Drawings. 1/2”-4” strainers shall be one-piece molded body with (3) ports to facilitate straight-thru flow pattern or u-shape flow pattern as required. Connections shall be true union type to ease installation/future maintenance. The cover, vent plug, and drain plug shall all be hand-removable, requiring no tools. EPDM or Viton seals shall be used as required for chemical service, and internal baskets shall be 1/32” perforation (20-mesh) for 1/2”-1” sizes, and 1/8” perforation for 1-1/2”-8” sizes. 6” and 8” strainers shall be fabricated construction and shall contain flanged connections as standard. The pressure rating for

1/2”-8” sizes shall be 150 psi @ 70°F, non-shock. Strainers shall be manufactured by Hayward Industrial Products, or equal.

2.06 QUICK DISCONNECT COUPLINGS

A. Quick disconnect type coupling for compressed/service air shall be provided where indicated on the Drawings. Coupling shall provide for instantaneous shutoff in socket end when lines are disconnected. Couplings shall be constructed of 316 stainless steel with a BUNA-N O-ring and integral safety lock. Couplings shall comply with Military Specification 4109 (interchangeable with standard plug of the same size).

2.07 BACKFLOW PREVENTERS

A. Backflow preventer shall be the size shown on the Drawings and shall be of the double check valve principle. Backflow preventer installation shall include isolation valves and four test cocks, furnished as an assembly. For backflow preventers less than 2-1/2", the installation assembly also shall include a strainer. Isolation valves for backflow preventers shall be ball valves, except for size 2-1/2" and larger which shall be resilient seat gate valves. Test cocks shall be located as recommended by the manufacturer to facilitate functional testing of the assembly. The backflow preventer shall be a WATTS 709, or equal.

B. Reduced Pressure Backflow Preventer shall be of the size shown on the Drawings, and shall be of the reduced pressure principle type in accordance with AWWA Standards C510 and C511, with two (2) independent operating spring loaded check valves and one (1) spring loaded, diaphragm actuated, differential pressure relief valve shall be installed between the check valves. Backflow preventer shall be bronze body construction, with EPT rubber discs and Buna-N and nylon diaphragm. Screws and springs shall be of stainless steel. End connections shall be screwed, unless otherwise specified or shown on the Drawings. Reduced pressure backflow preventer installations shall include isolation valves and four test cocks, furnished as an assembly. For reduced pressure backflow preventers less than 2-1/2" the installation assembly also shall include a strainer. Isolation valves for reduced pressure backflow preventers shall be ball valves, except for sizes 2-1/2" and larger which shall be resilient seat gate valves. Test cocks shall be located as recommended by the manufacturer to facilitate functional testing of the assembly. The reduced pressure backflow preventer shall be as manufactured by Beeco Division, Hersey Products Inc., Aergap Model 6CM, WATTS 909, or equal.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Except where noted otherwise herein, all valves shall be installing and tested in accordance with the latest revision of AWWA C500. Before installation, all valves shall be lubricated, manually opened and closed to check their operation and the interior of the valves shall be thoroughly cleaned. Valves shall be placed in the positions shown on the Drawings. Joints shall be made as directed under the Piping Specifications. The valves shall be so located that they are easily accessible for operating purposes, and shall bear no stresses due to

loads from the adjacent pipe. The Contractor shall be responsible for coordinating connecting piping.

B. All valves shall be tested at the operating pressures at which the particular line will be used. Any leakage or "sweating" of joints shall be stopped, and all joints shall be tight. All motor operated and cylinder operated valves shall be tested for control operation as directed by the Engineer.

C. Provide valves in quantity, size, and type with all required accessories as shown on the Drawings.

D. Install all valves and appurtenances in accordance with manufacturer's instructions. Install suitable corporation stops at all points shown or required where air binding of pipe lines might occur. Install all valves so that operating handwheels or wrenches may be conveniently turned from operating floor but without interfering with access, and as approved by Engineer. Unless otherwise approved, install all valves plumb and level. Valves shall be installed free from distortion and strain caused by misaligned piping, equipment or other causes.

E. Valve boxes shall be set plumb, and centered with the bodies directly over the valves so that traffic loads are not transmitted to the valve. Earth fill shall be carefully tamped around each valve box to a distance of 4 feet on all sides of the box, or to the undisturbed trench face, if less than 4 feet.

3.02 SHOP AND FIELD TESTING

A. Shop and field testing of valves shall be as follows:

1. Certified factory testing shall be provided for all components of the valve and operator system. Valves and operators shall be shop tested in accordance with the requirements in the latest revision of AWWA C500, including performance tests, leakage test, hydrostatic tests, and proof-of-design tests. The manufacturer through the Contractor shall submit certified copies of the reports covering the test for acceptance by the Engineer.

2. Shop testing shall be provided for the operators consisting of a complete functional check of each unit. Any deficiencies found in shop testing shall be corrected prior to shipment. The system supplier through the Contractor shall submit written certification that shop tests for the electrical/pneumatic system and all controls were successfully conducted and that these components provide the functions specified and required for proper operation of the valve operator system.

3. The Contractor shall conduct field tests to check and adjust system components, and to test and adjust operation of the overall system. Preliminary field tests shall be conducted prior to start-up with final field tests conducted during start-up. The factory service representative shall assist the Contractor during all field testing and prepare a written report describing test methods, and changes made during the testing, and summarizing test results. The service representative shall certify proper

operation of the valve operator system upon successful completion of the final acceptance field testing.

4. Preliminary and final field tests shall be conducted at a time approved by the Engineer. The Engineer shall witness all field testing.

5. All costs in connection with field testing of equipment such as energy, light, lubricants, water, instruments, labor, equipment, temporary facilities for test purposes, etc. shall be borne by the Contractor. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the County formally takes over the operation thereof.

6. Preliminary field tests shall be conducted prior to start-up and shall include a functional check of the entire valve operator system and all system components. Preliminary field tests shall demonstrate that the valve operator system performs according to specifications and that all equipment, valves, controls, alarms, interlocks, etc., function properly. The preliminary field test report must be approved by the Engineer prior to conducting final field acceptance tests. Based on results of preliminary field tests, the Contractor shall make any adjustments required to settings, etc., to achieve the required valve closing time and operation specified or otherwise directed by the Engineer.

7. Final field acceptance tests shall be conducted simultaneously with the start-up and field testing of the pumps, air compressors, process air blowers, etc. Field tests shall be conducted for the full range of operating modes and conditions specified and as directed by the Engineer. Each of the valves shall be tested at minimum, maximum, and normal head/flow conditions, and under all specified conditions of opening and closing. Performance of pneumatic valves and compressed air system under normal operating conditions and during simulated power failures shall be checked.

8. Field testing shall include optimization of opening and closing times of the valves. The Contractor shall provide the means for accurate measurement of pipeline pressures as directed by the Engineer. Valve opening and closing times shall be adjusted based on process requirements to optimize operation of the valves. Final valve opening and closing times as determined by field tests shall be approved by the Engineer prior to final acceptance of the system.

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SECTION 15105 – CHECK VALVES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall furnish and install check valves, complete and operable, as shown and specified herein, including epoxy coating, appurtenant and accessories, all in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 15100 - Valves and Appurtenances

PART 2 -- PRODUCTS

2.01 SWING CHECK VALVES

A. Unless otherwise specified, check valves 3-inches and less shall be bronze, Y-pattern, swing check valves of the regrinding type. Valves shall have a minimum 200 psi non-shock cold water pressure rating and shall be as manufactured by Jenkins Bros. Corp., Crane Company, or equal.

B. Check valves larger than 3-inches shall be cushioned swing check valves rated for a minimum working pressure of 200 psi and shall be APCO Series 6000, Figure 250D as manufactured by G.A. Industries, Milliken CCNE Model 9001, or equivalent as manufactured by Mueller Company.

C. Valve closure shall be controlled by an external weighted lever arm, the action of which is cushioned by a hydraulic oil or pneumatic cylinder. Counterweights and cushion cylinders shall be designed so that adjustments can be made in the field to minimize surge and to prevent backflow and hammering noises during actual service conditions. The hydraulic oil or pneumatic cushion system shall be completely self-contained.

D. Valve bodies, cover discs, levers, and disc arms shall be constructed of heavy cast iron or cast steel fully conforming to the latest revision of ASTM A-126 Class B or Class WCB, respectively. Valve ends shall be Standard American 125 pound flat-faced flanged, in accordance with ANSI B16.1. Each valve disc shall be suspended from a noncorrosive shaft which shall pass through a stuffing box and be connected on the outside of the valve to the cushion and counterweight mechanism.

E. Valve seating shall be rubber-to-metal designed for drop-tight shutoff. The body seat ring shall be made of bronze or stainless steel and the disc seat ring of 80 Durometer rubber. Body and disc seats shall be renewable.

F. With the exception of the valve body and seat, all parts in contact with water shall be manufactured from noncorrosive materials. Internal corrosive surfaces shall be shop

painted with two coats of epoxy for corrosion resistance. Exterior surfaces shall be painted in accordance with the requirements of Section 09900, Painting.

2.02 LIMIT SWITCH

A. Where applicable, the Swing Check Valves shall be provided with a Limit Switch to remotely indicate the OPEN/CLOSE status.

B. The Limit Switch shall be manufactured by Allen-Bradley Model 802M. The Limit Switch shall be a Factory Sealed, Corrosion Resistance type switch with a spring return lever. The enclosure shall be rated NEMA-4, UL listed. The electrical rating of the switch shall be SPDT 15 AMPS @120 Volts A.C. The pre-wired switch cable shall include a common wire, normally open wire and normally closed wire.

C. The Check Valve manufacturer shall provide a solid mechanical support to secure the Limit Switch. The Limit Switch support shall also be provided with a mechanical adjustment to properly position the snapping of the Limit Switch.

2.03 PVC AND CPVC BALL CHECK VALVES

A. Check valves shall be swing check type or ball check type manufactured from PVC or CPVC compounds. PVC shall comply with ASTM D 1784, 12454B. CPVC shall comply with ASTM D 1785, 23447B. Swing check valves shall be furnished with teflon seats, teflon seals and flanged end connections. Ball check valves shall be furnished with viton seats, and viton seals.

B. Ball check valves shall be provided on piping less than 3-inches in diameter. Ball check valves shall be true union type.

C. Manufacturers, or equal:

1. Asahi-America.

2. George Fischer, Inc.

3. Nibco, Inc. (GS Chemtrol).

2.04 PLASTIC SWING OR Y-CHECK VALVES

A. General: Plastic swing or Y-check valves for corrosive fluids, in sizes up to 8 inches or as available, may be used for horizontal or vertical up-flow conditions.

B. Construction: The valve bodies and discs or piston shall be of PVC, PP, or PVDF construction, as best suited for each individual service condition. They shall have flanged ends conforming to ANSI/ASME B16.5 – Pipe Flanges and Flanged Fittings, class 150, and flanged top access covers, and they shall shut positively at no-flow conditions. The seats and seals shall be of EPDM, Teflon, or Viton. The PVC valves shall be rated for a maximum non-shock working pressure of 150 psi at 73 degrees F for

sizes 3-inch and smaller. For larger sizes and other materials and temperatures the pressure rating will be lower.

C. Manufacturers, or equal:
   1. ASAHI – America

   2. George Fischer, Inc.

2.05 CHEMICAL TANK OVERFLOW FLANGE INLINE CHECK VALVES

A. Inline check valves shall be provided on the overflow piping of chemical tanks as shown on the Drawings. The valves shall be the same diameter as the overflow line.

B. The valves shall be of the flanged in-line type for installation between two mating ANSI B16.1 Class 125 flanges. Valve fabric-reinforced elastomer material shall be Viton elastomer for use in sodium hypochlorite service and VX456 or Sulfa Clear 8640-HF service. Valve elastomer material shall be EPDM for use in sodium hydroxide and polymer service.

C. Manufacturers, or equal:

   1. Tideflex Technologies, Series 37

   2. Cla-Val, Series DBI.

2.06 METAL INTERNAL SPRING-LOADED CHECK VALVES (GLOBE STYLE)

A. General: Internal spring-loaded check valves for water pumps, compressors, gas, air, and steam shall be of the full-flow internal spring-loaded poppet type. The valves shall be designed for a water-working pressure of not less than 150 psi unless otherwise indicated.

B. Body: The bodies of all valves in sizes 3-inch and larger shall be of cast stainless steel conforming to ASTM A 351, Gr. CF8M with Class 150 flanged ends. Where necessary, there shall be a positive, watertight seal between the removable seat and the valve body. The stem guide shall be integrally cast with the body, or screwed into the body.

C. Valves smaller than 3 inches shall have Gr. CF8M stainless steel bodies with screwed ends conforming to ANSI/ASME B 16.34 1.20.1 – Pipe Threads, General Purpose (inch), suitable for a minimum working pressure of 300 psi, unless otherwise shown indicated.

D. Disc and Stem: The disc and stem of all valves in sizes 3-inch and larger shall be of stainless steel conforming to ASTM A 351 Gr. CF8M. The stem shall have two-point bearings. The downstream bearing shall have a bushing, to provide a smooth operation.

E. Valves smaller than 3 inches shall have discs and retaining rings of Teflon, Nylon, or other suitable material, and stems of stainless steel, suitable for the intended service.

F. Stem Guide: The stem guide must be either firmly fixed in the valve body to prevent it from sliding into the adjacent pipe and damaging the pipe lining, or the valve manufacturer shall furnish each valve with one matching flange compatible with the adjacent pipe and its lining to prevent damage to the lining. The compatible flange shall be part of the shop drawing submittal.

G. Seat: All valves for general service at temperatures up to 250 degrees F shall have bubble-tight shut-off with resilient seats of Buna-N, Teflon, or other suitable material. Valves for steam service and temperatures over 250 degrees F shall have metal-to-metal seating stainless steel, as recommended by the manufacturer for the specific service condition. All resilient seats shall be firmly attached to the seating ring by compression-molding or other acceptable method.

H. Spring: All valves in sizes 3-inch and larger shall have Type 316 stainless steel springs, and valves smaller than 3-inch shall have stainless steel springs, as suitable for the service. The spring tension of the valves shall be designed for the individual pressure condition of each valve. Cracking pressure shall be ½ psi unless otherwise specified.

I. Manufacturers, or equal:

1. APCO (Valve and Primer Corp.)

2. Crispin

3. VAL-MATIC (Valve and Manufacturing Corporation)

PART 3 -- EXECUTION

3.01 GENERAL

A. All valves shall be installed in accordance with provisions of Section entitled “Valves and Appurtenances”.

B. All valve exteriors shall be painted as specified in the Section entitled "Painting." All exposed interior corrosive ferrous surfaces of valves 4 inches and larger shall receive a fusion bonded epoxy coating conforming to AWWA C550.

- END OF SECTION -

SECTION 15109

PLUG VALVES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Reference Section 15000, Basic Mechanical Requirements.

PART 2 -- PRODUCTS

2.01 PLUG VALVES

A. Plug valves shall be of the non-lubricated, eccentric seating plug type with synthetic rubber-faced plugs as manufactured by Clow, DeZurik Company, Milliken, Pratt, or equal. All valves shall be provided with limit stops and rotate 90° from fully open to fully shut. The minimum working pressure for all valves shall be 150 psi, and the test pressure shall be at least 270 psi for valves up through 12-inch and at least 230 psi for valves 14-inch and larger. The port area of valves shall be at least 80 percent of full pipe area for valves less than 24-inches and 70 percent for valves 24-inches and larger, unless otherwise specified herein or indicated in the appropriate Valve Schedule in Section 15390, Schedules. The body materials shall be of epoxy coated cast iron or semi-steel, unless specified otherwise. Seats shall have a welded overlay of 90 percent pure nickel and machined to a finish containing no stress cracks. Plug facings shall be of Hycar, or equal and completely suitable for use with domestic sewage.

B. Full port (100% of full pipe area) plug valves shall be furnished for all sludge applications.

C. The shaft seal shall be either the bronze cartridge type with at least two O-Rings, monolithic V-Type, or pull down packing type. If monolithic V-Type or pull down packings are utilized, it shall be self-adjusting, self-compensating type. Packing shall be as Chevron Type, or equal. Plug valves with pull down packings shall be designed with an extension bonnet so that repacking can be done without removal of the actuator.

D. All buried valves shall have mechanical joint ends (unless otherwise shown), conforming to ANSI A21.11. (AWWA C 111), and shall be operated with a standard AWWA 2-inch square nut through a totally enclosed worm gear actuator. Valve boxes shall be installed with all buried plug valves and shall be as specified herein.

E. Unless otherwise shown, all exposed valves 4-inches in diameter and larger shall have flanged ends conforming to ANSI B16.1-125/150 pound standard with face-to-face dimensions of standard plug valves. Valves smaller than 4-inches in diameter shall have screwed ends, unless otherwise noted.

F. Valves 8-inches in diameter and larger shall be handwheel or floorstand operated where required or indicated on the Drawings through totally enclosed worm gear actuators, unless otherwise specified or shown on the Drawings. Valves 6-inches in diameter and smaller shall have lever operators, unless otherwise specified or noted on the Drawings. Manual operators for plug valves mounted above 6 feet from the operating floor shall be equipped with worm gear chainwheel actuators.

G. The manufacturer shall certify that the plug valves are capable of operating in continuous duty service under these pressures and flow conditions.

H. Each valve shall by hydrostatically tested and tested for bubble tightness after the operator has been mounted and adjusted. Copies of the hydrostatic and leakage test certification and certification of conformance shall be submitted to the Engineer prior to shipment.

I. All internal and external ferrous components and surfaces of the valves, with the exception of stainless steel and finished or bearing surfaces, shall be shop painted with two coats (10 mils min. dry film thickness) of the manufacturer's premium epoxy for corrosion resistance. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 15114

MISCELLANEOUS VALVES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Reference Section 15000, Basic Mechanical Requirements.

B. Valves intended for chemical service shall be constructed of materials suitable for the intended service.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 15095 – Valves General

1.03 SUBMITTALS

A. The CONTRACTOR shall furnish submittals in accordance with Section 15095, Valves, General and Section 01300, Submittals.

PART 2 -- PRODUCTS

2.01 GLOBE VALVES (SERVICE/COMPRESSED AIR)

A. Globe valves (service/compressed air) shall be bronze body and bonnet with brass stem and stainless steel regrindable disc plug. Valves shall be Jenkins Valve Fig. 546-P, Crane Co., or equal with minimum 300 psi non-shock cold water pressure rating and screwed ends.

2.02 SURGE RELIEF VALVE

A. Valve Characteristics: the surge relief valve shall be an angle type valve designed to open when the inlet pressure exceeds a set maximum level. The valve shall fully open when the system operating pressure exceeds the set maximum level by 10% to relieve the pressure surge and close slowly as the system pressure returns to normal. The valve disc shall be normally closed against the system operating pressure by means of adjustable springs. Closing speed shall be controlled at an adjustable rate by a hydraulic oil cylinder.

B. Valve Body: The valve body shall be of cast iron, ASTM A48 – Specification for Gray Iron Castings, or ASTM A126 – Specification for Gray Iron Castings for valves, flanges and hinged fittings, with 125 lb flanged ends at ANSI/ASME B16.1 – Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800, or the body shall be of ductile iron to ASTM A536, Specification for Ductile Iron Pipe Flanges and Flanged

Fittings. The valve cover shall be flanged and shall be of cast iron or ductile iron. The interior of the valve body shall be coated with NSF 61 certified fusion bonded epoxy, 12 mils DFT minimum.

C. Valve Trim: The valve stem shall be of 300 – Series Stainless steel, the body seat ring shall be bronze or stainless steel and the valve stem guide shall be bronze. The disc seal shall be Buna-N-Rubber.

D. Valve Controls: The valve shall be furnished with externally adjustable springs, hydraulic cylinder and reservoir and closing speed control valve with locking device.

E. Factory Tests: All valves shall be factory tested with a hydrostatic test and a functional test and a test certificate shall be submitted to the ENGINEER prior to delivery of the valve.

F. Operating Conditions: Centrifuge feed pump surge relief valve shall be designed to operate under the following conditions:

1.	Total flow through centrifuge feed pump discharge line (gpm)	450
2.	Maximum inlet pressure (psi)	65
3.	Maximum outlet pressure (psi)	5
4.	Valve size (inches)	3
5.	Size of pipeline (inches, diameter)	6

G. Spare Parts: The following spare parts shall be furnished for each valve:
   1. 1 set of all resilient seals and seat rings.
   2. 1 hydraulic oil replacement fill.

H. Manufacturers:
   1. APCO Willamette - Series 3000
   2. Golden-Anderson Industries, Inc. - Series 6600

2.02 SOLENOID VALVES

A. Three-way two-position solenoid valves shall be of the two coil type. Both coils shall be normally closed and each shall open independently when energized. The valve shall be of forged brass-body and bonnet with a Buna "N" diaphragm and screwed ends. The solenoid's internal parts shall be of 300 and 400 series stainless steel. The valve shall have a safe body working pressure of 125 psi and shall be as manufactured by ASCO Valves, Automatic Switch Co., or equal, for 120V, 60 Hz, single phase operation. Solenoid enclosure shall be NEMA 4 watertight.

B. Two-way solenoid valves shall be normally closed and shall open when the solenoid is energized, unless otherwise noted. The valve shall be of forged brass-body and bonnet with a BUNA "N" diaphragm and screwed ends. The solenoid's internal parts shall be of 300 and 400 series stainless steel. The valve shall have a safe body working pressure of 125 psi, and shall be as manufactured by ASCO Valves, Automatic Switch Co., or equal, for 120 volt, 60 Hz, single phase operation. Solenoid enclosure shall be NEMA 4 watertight.

C. Four-way two-position solenoid valves shall be of the single coil type and shall be normally closed and shall open when the solenoid is energized (i.e. fail closed). The remainder of the four-way two-position solenoid valves shall be of the two coil type. Both coils shall be normally closed and each shall open independently when energized. The valve shall be of forged brass-body and bonnet with a Buna "N" diaphragm and screwed ends. The solenoid's internal parts shall be of 300 and 400 series stainless steel. The valve shall have a safe body working pressure of 125 psi and shall be as manufactured by ASCO Valves, Automatic Switch Co. or equal, for 120V, 60 Hz, single phase operation. Solenoid enclosure shall be NEMA 4 watertight. The solenoid valve shall be provided with a manual override.

2.03 PRESSURE RELIEF, REDUCING AND REGULATING VALVES

A. Pressure relief valves 1 inch and under shall have bronze bodies and above 1 inch shall have cast iron bodies, bronze fitted with grey iron diaphragm base and straight chamber and phosphorus bronze diaphragm. The ratio of the diaphragm area to the seat area shall be adequate to overcome sticking. The seat disc shall be of non-corrodible, non-sticking material capable of withstanding extreme temperatures. Valves shall permit dismantling for repairs and cleaning without being removed from the line. Valves shall conform to the ASME Boiler Construction Code as approved by both the Underwriters Lab., and the National Board of Boiler Pressure Vessel Inspectors. All valves shall be designed for a minimum working pressure at least equal to the working pressure of the corresponding pipeline and shall have adjustment over a range of at least 20 percent above or below the required setting pressure of the installation.

B. Pressure reducing and regulating valves (water service) 1/2-inch and under shall be bronze and above 1/2-inch shall have cast iron bodies bronze fitted. Valves shall be constructed with full openings and capable of supplying a full flow of water at reduced pressure. Valves shall be so constructed that repairs can be made without removing the valves from the line. The valves shall be equipped with a sedimentation chamber and stainless steel or bronze strainer. Pressure reducing and regulating valves shall be the back pressure sustaining type and shall operate over a range at differential pressures from 5 to 120 psi. Reducing and regulating valves shall meet or exceed the requirements of ASSE 1003 (ANSI A112.26.2) and shall be Model 616R, as manufactured by Fisher Controls, WATTS Series 25 AUB, GA, or equal.

2.04 AIR RELEASE VALVES

A. Air release valve assemblies shall be installed at all the locations specified herein or indicated on the Drawings and shall be installed complete with all appurtenant piping and valves as required for a complete and operable installation. Air-release valves shall vent accumulating air while system is in service and under pressure and shall be of the size indicated with flanged or screwed ends to match piping. Bodies shall be of high-strength cast iron, unless mounted on stainless steel piping, in which case the valve shall have cast CF8M stainless steel bodies. The float, seat, and all moving parts shall be constructed of Type 316 stainless steel. The orifice button/needle shall be of Buna-N. Valves shall be designed for a minimum water-working pressure of 150 psi, unless

otherwise indicated. The valves shall include isolation valve and backflushing attachments which shall consist of blow-off valves, quick disconnect couplings, and a minimum of 5 feet of rubber hose suitable for backflushing without dismantling the valve. All air release valves shall provide drip tight closure from 1 to 150 psig. The exhaust from the valve shall be piped to a suitable disposal point. All valves shall have a 1/4-inch min. diameter drain plug.

B. The air release valves shall have a 2-inch (minimum) threaded connection. The air release valves shall have a discharge capacity of 90 scfm, minimum, at a differential pressure range from 1 psi to 65 psi, and a minimum orifice of 1/4-inch diameter, minimum.

C. All internal and external ferrous components and surfaces of the valves, with the exception of stainless steel and finished or bearing surfaces, shall be shop painted with two coats (10 mils min. dry film thickness) of the manufacturer's premium epoxy for corrosion resistance. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.

D. The air release valves shall be similar to the following types and models as manufactured by the following:

1. APCO (Valve and Primer Corporation)

2. Crispin (Multiplex Manufacturing Company)

3. Val-Matic (Valve and Manufacturing Corporation)

2.06 HOSE VALVES

A. Hose valves shall be 300 lbs. non-shock cold water angle or globe valves, Fig. 112/113 as manufactured by Jenkins Valve Co., or equal. Valves shall be bronze bodied with Buna-N or neoprene disc and bronze bonnet and packing nut. Valve stem, gland, and lock nut shall be brass. Valve shall be provided with 3 inch diameter malleable iron handwheel, cap and chain, and 3/4-inch or 1-inch (or 2 inch near flushing connections) hose connection outlet.

2.07 NEEDLE VALVES

A. Needle valves shall be bronze body and spindle with follower gland and shall be 400 psi, non-shock cold water needle valves, Figure 743-G as manufactured by Jenkins Bros., Corp., Crane Co. No. 88, or equal.

B. Needle valves (service air) shall be bronze body, with stainless steel stem. Valves shall be Jenkins Valve Fig. 741G, Crane Co. or equal and shall have minimum 400 psi non-shock cold water pressure rating and screwed ends.

2.08 VENTED BALL VALVES

A. All Vented Ball Valves, sizes 1/2” to 4”, shall be of true union design with two-way blocking capability. All O-rings shall be EPDM with PTFE seats. PTFE seats shall have elastomeric backing cushion of the same material as the valve seals. Stem shall have double O-rings and be of blowout-proof design. The valve handle shall double as carrier removal and/or tightening tool. ISO mounting pad shall be integrally molded to valve body for actuation. PVC material shall conform to ASTM D1784 Cell Classification 12454-A. The ball valves shall have a pressure rating of 230 psi for sizes”1/2” to 3” and 150 psi for 4” at 70ºF. Vented Ball Valves must carry a two-year guarantee, as manufactured by Asahi, Hayward, IPEX, GF+, or equal.

2.09 BACKFLOW PREVENTERS (1/2-INCH THROUGH 10-INCH)

A. Backflow preventers shall be of the reduced pressure assembly type and shall contain two spring loaded check valves and one spring loaded, diaphragm actuated, differential pressure relief valve. The unit shall include tightly closing shut-off valves located at each end of the device and shall be fitted with properly located test cocks. Operation shall be completely automatic. All parts shall be removable or replaceable without removal of the unit from the line. All materials shall be protected against corrosion. Backflow preventers ½ to 2-inch shall be as manufactured by Watts Model LF919 or Wilkins Model 975XL2, no substitutions. Backflow preventers 2-½ to 10-inch shall be as manufactured by Watts Model 957 or 994, Ames Model 4000ss, Colt Model C400, Maxim Model M400, or Wilkins Model 375, no substitutions.

- END OF SECTION -

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SECTION 15115

PVC/CPVC VALVES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Reference Section 15000, Basic Mechanical Requirements.

PART 2 -- PRODUCTS

2.01 MATERIALS OF CONSTRUCTION

A. Valves provided for chemical service shall be constructed of materials suitable for the intended service. PVC valves shall be provided in PVC piping and CPVC valves shall be provided in CPVC piping.

B. Valve bodies shall be constructed of Class 12454-B PVC or Class 23447-B CPVC.

C. Acceptable elastomer materials for each chemical service shall be as follows

Chemical	**Acceptable Gasket Material**
Sodium Hypochlorite	Viton

2.02 PVC/CPVC BALL VALVES

A. Ball valves shall have 125 psi minimum non-shock cold water pressure rating. Valves shall have integral unions with socket, flanged or threaded ends as required and as specified in Section 15390 and shall have removable handles. Valves shall be manufactured by ASAHI/AMERICA, Chemtrol Products Division of NIBCO, Inc., IPEX Industrial Thermoplastics, Hayward Industrial Products, or equal.

B. Ball valves for sodium hypochlorite service shall be single-seal type valves. The ball shall be drilled by the valve manufacturer at the factory and installed with vent hole facing upstream. The pressure rating shall be a minimum of 125 psi at 70°F.

2.03 PVC/CPVC SWING CHECK VALVES

A. Swing check valves shall have an external lever and weight. Check valves shall have socket, flanged, or threaded ends as specified in Section 15390. Valves shall be capable of top entry to facilitate cleaning and repair without removal from the line. Valve shall incorporate a single disc design. Check valves shall be as manufactured by ASAHI/AMERICA, or equal.

2.04 PVC/CPVC BALL CHECK VALVES

A. Ball check valves shall have 150 psi minimum non-shock cold water pressure rating and integral union with socket, flanged or threaded ends as specified in Section 15390. Valves shall be as manufactured by ASAHI/AMERICA, Chemtrol Products Division of NIBCO, Inc., Hayward Industrial Products, or equal.

2.05 PVC/CPVC DIAPHRAGM VALVES

A. Diaphragm valves shall have socket, flanged or threaded ends as specified in Section 15390 and shall have a position indicator and adjustable travel stop. Diaphragm valves shall be similar to Type G, as manufactured by ASAHI/AMERICA, Hayward Industrial Products, or equal.

2.06 PVC/CPVC BUTTERFLY VALVES

A. Butterfly valves shall be wafer style and shall have polypropylene discs. Butterfly valves shall provide bubble-tight seating, with 316 stainless steel shaft and gear operator, and shall be as manufactured by ASAHI/AMERICA, Hayward Industrial Products, or equal.

2.07 PVC/CPVC BUTTERFLY CHECK VALVES

A. Butterfly check valves shall have flanged ends or be wafer-style, as shown on the Drawings. Body and internal materials shall be PVC or CPVC, and elastomer materials shall be completely resistant to corrosion by the chemical being conveyed. Valves shall be elastomer hinged check valves with unrestricted full-port seatless design, tight shutoff, and the ability to be mounted in any position. Valves shall be Techno Multi-Purpose Check Valves by Cameron, or equal.

- END OF SECTION -

SECTION 15207

SLIDE GATES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish, shop test, install, paint, adjust, field test and make fully operational the slide gates and actuators of the number and size required by the equipment suppliers associated with each type of gate, complete with all necessary supports, hardware, and accessories, as specified herein, shown on the Drawings, and as required for a complete and operable system. Gates and actuators to be supplied shall be as follows:

1. One (1) centrifuge cake discharge diverter gate – to be supplied with and under Section 11375 by the centrifuge manufacturer

2. Four (4) sludge loading conveyor loading gates – to be supplied with and under Section 14554 by the conveyor manufacturer

B. Each gate shall be provided with a 120V electric actuator.

C. Gate orientation and dimensions shall all for installation as shown on the Drawings with all parts requiring maintenance and/or replacement readily assessible from the elevated cat walk provided for the conveyor.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 11375 – Centrifuge Equipment

H. Section 14554 – Conveyor Equipment

I. Division 16 - Electrical

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

1. AGMA - American Gear Manufacturers Association

2. AWS - American Welding Society

3. NEMA - National Electrical Manufacturers Association

4. AFBMA - Anti Friction Bearing Manufacturers Association

5. ANSI - American National Standards Institute

6. NFPA - National Fire Protection Association

7. ASTM - American Society for Testing Materials

1.04 SUBMITTALS

A. Submit information in accordance with Section 01300, Submittals. Include:

1. catalog information and complete dimensional drawings for the gate and actuator

2. catalog information on solenoid and pilot tubing materials

3. dimensional drawings shown the orientation and location of the gates, actuators, tubing routes and solenoid valves in relation to the connected equipment

1.05 CONTRACTOR'S RESPONSIBILITY

A. The Contractor shall coordinate all details, locations, clearances, and other conditions with the various equipment suppliers, so that the slide gates function as part of a complete system.

B. The Contractor shall provide the services of a qualified manufacturer's technical representative who shall adequately supervise the installation and testing of all equipment furnished under this Contract and instruct the Owner's operating personnel in its maintenance and operation in accordance with the General Requirements. The services of the manufacturer's representative shall be provided for a period of not less than two (2) days in up to two separate trips to check and supervise the equipment installation and field tests and then to provide the required training.

C. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor.

D. A written report covering the representative's findings and installation approval shall be submitted, covering all inspection and outlying in detail any deficiencies noted.

E. The times specified are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.

1.06 QUALITY ASSURANCE

A. The slide gates and associated actuators and solenoids shall be of the same manufacturer, type, and general configuration for consistency in operation and maintenance procedures, regardless of who supplies the gates and actuators. The gate manufacturer shall have a minimum of five years experience constructing such systems.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Provide products manufactured by one of the following:

1. Jim Myers and Sons, Inc. Bio-Gate, Charlotte, NC, (704)554-8397

2. Atara Leak Proof Slide Gates, Laval, Quebec, (514)931-5445

3. Or approved equal

2.02 MATERIALS

A. Gate, frame, and cover/bonnet shall be of all 304 stainless steel construction fabricated from structural shapes and plates.

B. Stationary gate guides and wedges shall be stellite hardfaced to prevent gallings. If gate rollers are used, they shall be corrosion resistant and designed to be jam-proof.

C. Sealing gasketing subject to sliding shall be self-lubricating.

2.03 DESIGN REQUIREMENTS

A. Slide gate for the centrifuge discharge shall be centered beneath the centrifuge gate discharge chute and shall allow for diversion of flow straight down to the loading conveyor when in the “normal” position and divert “slops” without leakage to the adjacent drain line when in the “closed” position.

B. The slide gates on the loading conveyor shall each be centered beneath the associated discharge chute to the truck below and shall allow cake material to pass down through the associated chute when “open” or allow cake material to pass by the associated chute when “closed”.

C. Gates shall be fabricated as follows:

1. Gates shall be heavy duty, single blade slide gates, with self-cleaning internals.

2. Gate wiping seals shall be made of neoprene and shall contact the top of the gate blade along the perimeter of the throat opening.

3. Gates shall be capable of operating independently and each gate shall be provided with its own actuator.

4. The minimum thickness of the gate materials shall be 3/8-inch, minimum. The gates shall include heavy duty bolted coverplates arranged to cover the gate when in the retracted position and to facilitate maintenance. Greater thickness shall be provided based on actual actuator thrust forces.

5. General mounting width of the slide gate shall not exceed 12-inches face-to-face between flanges.

D. Slide gate valves shall be designed to prevent wedging of sludge cake material between the gate edge and valve body.

E. The Diverter Gate valve for Centrifuge slop diversion shall be designed for 30 psig.

F. Slide gate frames shall be designed to withstand the thrust of the actuator.

G. For the purpose of this specification, leakage and drippage are defined as follows:

1. Leakage for the centrifuge diverter gate is the liquid which bypasses the seals drips from the gate to the truck below when in the “closed” position. Leakage for this slide gate shall exhibit no dripping through the gate at a head of 5 psig.

2. Leakage for the truck loading gates on the conveyor is moisture from the dewatered cake resting on the gate when in the “closed” position. Leakage for these slide gates shall exhibit no dripping through the gate.

2.04 ELECTRIC ACTUATORS

A. Slide gates shall be satisfactorily actuated when subjected to a head of 10 psig or greater.

1. Power for the actuators shall be through a 120V, single phase source from the building lighting panel as shown on the Drawings.

2. Actuators shall be Harold Beck Model 42-103 linear actuator, Newtown, PA, (215-968-4600), or approved equal.

3. Simple open/close (extend/retract) operation - direct AC to the motor shall drive the unit to fully open or fully closed position. Limit switches at each end of travel shall stop the drive and available to be used for external signaling of actuator status.

4. Stroke length shall be up to 18”, 4.2 seconds operating time, 1000 lbs thrust. Verify with gate manufacture actual stroke length and thrust requirements.

5. Power requirements: 144 watts, 1.2 amps, maximum at 120VAC.

6. Operating Conditions: –40° to 185° F, 0 to 99% relative humidity

7. Minimum Step: 0.1° of span

8. Hysteresis: 0.25% of span at any point

9. Over-thrust Protection: If the output thrust of the drive exceeds 150% of the drive rating, the motor will shut off (feature can be enabled / disabled)

10. Stall Protection: If the motor tries to run in one direction for more than 300 seconds (configurable from 30 to 300 seconds), the motor will shut off

11. Over-travel Protection Switches: Two Form C (Retract and Extend) provide over-travel protection

12. Auxiliary Switches (Field Adjustable): Two Form C, rated for 1 A, 250 V ac

13. Handswitch: Open/Close/Remote switch integral to the actuator to allow manual operation at the gate or remote operation when in Remote.

14. Handwheel: Provides manual operation without electrical power

15. Motor: 120 Vac, single-phase, no burnout, noncoasting. Capable of 60 starts per minute, outdoor rated, corrosion resistant.

16. Enclosure: Precision-machined aluminum alloy castings, painted with corrosion-resistant polyurethane paint, to provide a rugged, dust-tight, weatherproof enclosure designed to meet NEMA 4X standards

17. Control Interface: The gates/actuators shall be factory pre-assembled and factory tested, factory pre-wired to the greatest extent practical. Field connections shall terminate on screw-type terminal boards located in waterproof junction boxes. Wiring, conduit, and junction boxes shall comply with Division 16. Signal interface back to the CCP shall include wiring and terminals in the junction box for
    a. Gate opened
    b. Gate closed
    c. Open gate command
    d. Close gate command
    e. Fault
    f. In Remote

2.05 SUPPORTS

A. Contractor shall provide all supports for support of the gate and actuator. Type and location of supports shall be acceptable to Engineer. Supports shall be of the same material as the gate.

2.06 SAFETY

A. All necessary safety equipment and guards to meet OSHA requirements shall be provided.

PART 3 -- EXECUTION

3.01 TESTS

A. After installation, test each gate for a minimum of 5 full cycles of operation to test for any deficiency in time of travel, ease of travel, apparent full seating and unseating, and proper response for control interface in manual and automatic operation and status signal changes.

B. After startup, test each gate under actual intended operation to check for drip leaks when in the closed position. Preliminary tests for leakage may be performed as directed by the manufacturer but final tests shall be under actual working conditions. Any drip leaks found shall be corrected at no additional cost to the Owner.

3.02 WORKMANSHIP

A. Workmanship shall be of first-class quality.

B. Work shall be coordinated with discharge chutes, and other equipment to avoid conflicts and interferences.

C. Installation shall be in accordance with the manufacturer's installation instructions.

D. All sections and loose items shall be match-marked prior to shipping.

3.03 SPARE PARTS

A. The manufacturer shall furnish all special tools necessary to disassemble, service, repair and adjust the equipment.

B. The following spare parts shall be provided for each gate:

1. One set of seals for all seals used.

2. One set of piston rod bushings.

3. One spare solenoid valve.

- END OF SECTION -

SECTION 15864

FANS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish, install, and make fully operational, Fans and accessories as shown on the Drawings and specified herein.

B. The Drawings show general arrangement, location, accessories and special coating requirements.

C. Related work as called for on Drawings or specified in this or other Technical Specification Sections.

1.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

A. Performance Requirements

Quantity:	4
Service:	Ambient Air
Min. Airflow at High Speed (CFM):	10,000
Maximum Speed (RPM):	1,800
Power Usage at Max. Speed (W):	600
Max. Sound Level (dBA):	81
Min. Fan Diameter (inches):	30
Max. Motor Horsepower (Hp):	1
Min. Oscillations per Minute:	2

1.03 SUBMITTALS

A. Data for all equipment (Fans and motors) is to be submitted concurrently.

B. The following items shall be submitted with the Shop Drawings in accordance with, or in addition to the submittal requirements specified in Section 01300, Submittals; and Section 11000, Equipment General Provisions:

1. Product data for selected models, including specialties, accessories, and the following:

061713BR

a. Fan performance curves with specified operating point clearly plotted.

b. Sound power levels for both fan inlet and outlet at rated capacity.

c. Motor ratings and electrical characteristics plus motor and fan accessories, including recommended breaker size for power feed to fan.

d. Materials gages and finishes, including color charts.

2. Drawings detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.

3. Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer-installed wiring and field-installed wiring.

C. Operation and Maintenance Manuals in accordance with 01730 – Operation and Maintenance Manuals

D. Furnish certified report prepared by manufacturer's technical representative certifying satisfactory installation, operation and in-service placement of units.

1.04 QUALITY ASSURANCE

A. NEMA Compliance: Motors and electrical accessories to comply with NEMA standards.

B. Electrical Component Standard: Components and installation to comply with NFPA 70 "National Electrical Code".

C. All fans are to be OSHA compliant.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver, in manufacturer's original unopened packaging with brand name clearly marked and showing, to jobsite with sufficient protection, bracing, etc. to ensure arrival in acceptable and undamaged condition.

B. Lift and support units with the manufacturer's designated lifting or supporting points.

C. Store in original containers on level supports and protect materials from damage and exposure to the elements until installed. Do not keep in storage for over 90 days.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the requirements of this Section, the following manufacturers have the capability of performing the work in this Section:

1. Big Ass Fans Model Yellow Jacket or pre-approved equal

2.02 GENERAL

A. Provide fans that are factory-fabricated and assembled, factory-tested, and factory-finished, with indicated capacities and characteristics.

B. Base fan performance at standard conditions (density 0.075 Lb/ft^3).

C. Selected fans selected are to be capable of accommodating static pressure and flow variations of +/-15% of scheduled values.

D. Fans are to be mounted to concrete columns 10 – 15 feet from the floor. Remote ground level controls shall be included to provide fan on/off, oscillation on/off, and variable speed control.

E. Mounting: The entire fan and motor assembly is to be mounted on vibration isolators to reduce noise transmission.

F. Rotating Assembly: Statically and dynamically balanced to balance grade G6.3 per ANSI S2.19 and designed for continuous operation at the maximum rated fan speed and motor horsepower.

G. Fan housing shall be heavy duty construction designed for corrosive environment.

H. Oscillation angle shall be adjustable with a minimum of 45 degrees of adjustment.

2.03 FAN MOTORS AND DRIVE

A. Motors:

1. Motor construction and features per applicable specification section except as modified herein.

2. Motor Sizes: Minimum sizes and electrical characteristics as indicated. Motor to be large enough so that the driven load will not require the motor to operate in the service factor range.

3. Torque Characteristics: Sufficient to accelerate the driven loads satisfactorily.

4. Motor and drive to be mounted on vibration isolators.

5. Provide motor with an adjustable base for varying belt tension and belt alignment.

6. Motor shall meet the requirements specified in the table below.

Fans

Rating	120V, 1 ph, 60 Hz
Horsepower (max)	1.0
Speed, rpm	1800
Enclosure	TEFC
Insulation	Class F
Service Factor	1.15
Space Heater	No
Motor Winding Temperature Switches	No

2.04 SOURCE QUALITY CONTROL

A. Testing Requirements: The following factory tests are required on a prototype:

1. Sound Power Level Ratings: Comply with AMCA Standard 301 “Method for Calculating Fan Sound Ratings From Laboratory Test Data”. Test fans in accordance with AMCA Standard 300 “Test Code for Sound Rating”. Fans to be licensed to bear the AMCA Certified Sound Ratings Seal.

2. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA Standard 210/ASHRAE Standard 51 - Laboratory Methods of Testing Fans for Rating.

PART 3 -- EXECUTION

3.01 GENERAL

A. Examine areas and conditions for compliance with requirements for installation tolerances, and other conditions affecting performance of fans.

B. Do not proceed until unsatisfactory conditions have been corrected.

C. Install fans level and plumb, in accordance with manufacturer’s written instructions. Support units as described below, using the vibration control devices indicated. Secure fans with stainless steel hardware.

D. Arrange installation of units to provide access space around ventilation fans for service and maintenance.

E. Electrical Connections: The following requirements apply:

1. Electrical power wiring is specified in electrical Sections.

2. Control and interlock wiring are to be as specified.

3. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

4. Install fans with flexible electrical leads.

3.02 FIELD QUALITY CONTROL

A. Final Checks before Start-Up: Perform the following operations and checks before start-up:

1. Remove shipping blocking and bracing.

2. Verify unit is secure on mountings and supporting devices and that connections for ductwork, and electrical are complete.

3. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operations. Reconnect fan drive system.

4. Lubricate bearings, pulleys, and other moving parts with factory-recommended lubricants.

B. Starting Procedures for Fans:

1. Energize motor; verify proper operation of motor, drive system. Adjust fan to indicated RPM.

2. Measure and record motor electrical values for voltage and amperage.

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SECTION 15995

PIPELINE TESTING AND DISINFECTION

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall perform flushing and testing of all pipelines and appurtenant piping, complete, including conveyance of test water from Owner designated source to point of use and all disposal thereof, all in accordance with the requirements of the Contract Documents.

B. Reference the Section entitled “Summary of Work” for construction sequencing restrictions.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

ANSI/AWWA B300 Hypochlorites

ANSI/AWWA B301 Liquid Chlorine

ANSI/AWWA C651 Disinfecting Water Mains

ANSI/AWWA C600 Installation of Ductile Iron Water Mains and their Appurtenances

1.03 SUBMITTALS

A. A pumping and transmission equipment, testing schedule, including proposed plans for water conveyance, control, disposal, and disinfection shall be submitted in writing for approval a minimum of 48 hours before testing on any particular pipeline is to commence.

B. The CONTRACTOR shall submit disinfection test reports and hydrostatic test reports in accordance with Sections entitled “Submittals” and “Project Closeout”.

PART 2 -- PRODUCTS

2.01 MATERIALS REQUIREMENTS

A. All test equipment, temporary valves or bulkheads, or other water control equipment and materials shall be determined and furnished by the Contractor subject to the Engineer's review. No materials shall be used which would be injurious to the construction or its future function.

PART 3 -- EXECUTION

3.01 GENERAL

A. Unless otherwise provided herein, water for testing pipelines will be from an Owner furnished source; however, the Contractor shall make all necessary provisions for conveying the water from the Owner-designated source to the points of use.

B. All pressure and gravity pipelines shall be tested. All testing operations shall be performed in the presence of the Engineer.

3.02 TESTING OF PIPELINE

A. All equipment, including, but not limited to, pumps, gauges, and special fittings required to perform the testing shall be provided by the Contractor. The Contractor shall perform all excavation and other work required to locate and repair leaks and correct other defects which may be disclosed or develop under tests. The Contractor shall replace all coating, painting, backfill, or other permanent work removed in locating or repairing leaks and correcting defective piping. All gauges and control devices connected to lines being tested must be disconnected for the duration of the test. Water shall not be used in testing air lines, chlorine gas lines, or other gas carrying pipes. All tests shall be witnessed by the Engineer.

B. Prior to testing, all pipelines shall be flushed or blown out as appropriate. The Contractor shall test all pipelines either in sections or as a unit. No section of the pipeline shall be tested until all field-placed concrete or mortar has attained an age of fourteen days. The test shall be made by closing valves when available, or by placing temporary bulkheads in the pipe and filling the line slowly with water. The Contractor shall be responsible for ascertaining that all test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to, or movement of, the adjacent pipe. Care shall be taken to see that all air vents are open during filling.

C. The pipeline shall be filled at a rate which will not cause any surges or exceed the rate at which the air can be released through the air valves at a reasonable velocity and all the air within the pipeline shall be properly purged. After the pipeline or section thereof has been filled, it shall be allowed to stand under a slight pressure for at least twenty-four hours to allow the concrete or mortar lining, as applicable, to absorb water and to allow the escape of air from any air pockets. During this period, bulkheads, valves, and connections shall be examined for leaks. If leaks are found, corrective measures satisfactory to the Engineer shall be taken.

D. Gravity sewer pipe or other pipe having free surface flow shall be given a water exfiltration test as specified herein. The Contractor has the option of using a low pressure air test in lieu of the water exfiltration test. If excessive groundwater is present which precludes use of the exfiltration test, the Contractor shall use either the low pressure air test or infiltration test.

E. Water lines, sewage force mains and other pressure piping carrying liquids having bell and spigot gasketed joints shall be given a pressure and leakage test in accordance with AWWA C-600 unless specifically modified herein.

F. CPVC, steel, ductile iron or other pipe material, with solvent welded, welded, threaded, flanged, grooved end or flexible couplings and joints shall be pressure tested as specified above. No leakage shall be permitted.

G. No special pressure or leakage testing is required for gravity storm drain pipes. Leakage shall be minimized by installation in a workmanlike manner with no visible sources of leakage in accordance with the manufacturer's recommendations.

H. Pressure air and gas piping carrying air or other gasses under pressure shall be given a pressure test as specified herein. No leakage is permitted. Low pressure air piping shall be tested pneumatically. Air pressure of 20 pounds per square inch shall be applied to piping and fittings. High pressure air piping shall be tested to 200 psi unless otherwise specified. There shall be no drop in pressure in a 24-hour period. Leaks shall be located and repaired to the satisfaction of the Engineer. Pressure drops due to thermal contraction are acceptable if the pressure returns to the original test pressure after 24 hours.

I. Vent piping shall be filled with water to the top of the system for a period of 24 hours with no measurable leakage.

J. Pressure Tests

1. All pressure piping carrying liquids, including valves, shall be field-tested at a hydrostatic pressure equal to the pipe pressure class, corrected to the elevations of the test gauge, with duration of two hours minimum, for each pressure test, unless code requirements dictate a longer duration. Air piping shall be tested using air or nitrogen. Pressure tests shall be recorded by the Contractor. Copies of all test report forms shall be forwarded to the Engineer.

2. Temporary or permanent thrust blocks or bulkheads or restrained joints shall be placed as required prior to tests, and the Contractor shall provide all necessary braces, plugs, thrust blocks, caps, flanges, and other materials to permit proper performance of the pressure testing; tests shall not be conducted until it concrete thrust blocks are capable of withstanding the loads produced.

K. Leakage Tests: Leakage tests shall be conducted concurrently with the pressure test. The allowable leakage shall be determined in accordance with AWWA C-600. The duration of the test shall be not less than two hours. Measurement shall be made by means of a calibrated suction tank showing the amount of water required by the test pump to accurately maintain the specified test pressure. Tests shall be performed only in the presence of the Engineer, or, if scheduling of tests is such that the Engineer cannot attend due to conflicting commitment, tests may be performed without the Engineer's presence if the Contractor obtains written permission to do so from the Engineer prior to initiation of testing. No test report will be accepted unless proof of compliance with the foregoing requirement accompanies the test report. Low pressure air test shall be conducted in conformance with ASTM C-828.

L. In the case of pipelines that fail to pass the prescribed leakage test, the Contractor shall determine the cause of the leakage, shall take corrective measures necessary to repair the leaks, and shall repeat the test until the testing requirements are met.

3.03 FLUSHING

A. All piping shall be flushed clean of all dirt and foreign material following completion of the hydrostatic and leakage test. Air and gas piping shall be purged with air or nitrogen gas as directed by the Engineer.

B. Equipment and Supplies. The Contractor shall provide all equipment, and supplies for performing the work, and shall waste the water at locations or by procedures approved by the Engineer.

3.04 DISINFECTION

A. Disinfection of potable water lines shall be performed in accordance with AWWA Standard C-651, State of Florida and local applicable regulations. The Contractor shall provide a Disinfection Plant to the Engineer for approval. The Contractor shall be responsible for furnishing fittings and all special pipe taps required by the pipe disinfection work.

3.05 DISINFECTION

A. Provide list of equipment required and a disinfection plan to execute the Work of this Section.

B. Inject the required amount of disinfectant to yield a minimum chlorine content of 50 ppm into piping system.

C. Allow solution to remain in the pipes for twenty-four hours or longer, if required, to destroy all harmful bacteria.

D. Operate all valves and other appurtenances during disinfection to assure the sterilizing mixture is dispersed into all parts of the system.

E. After the solution has been retained for the required time, pipes shall be flushed and filled with municipal domestic water. Sterilizing water shall be disposed of in an approved manner. Sterilizing water shall not be allowed to flow into a waterway without reducing chlorine concentrations to a safe level. The CONTRACTOR shall be responsible for meeting all applicable requirements and acquiring all necessary permits for this work.

F. Take one bacteriological sample and test from every segment of pipeline tested. Samples shall be taken and tested on each of two successive days. CONTRACTOR shall submit sample to a laboratory, approved by ENGINEER, for testing. The disinfection process shall be repeated if laboratory test results reflects presence of harmful bacteria in the water.

3.06 TESTS

A. Provide analysis of treated water to meet standards and received acceptance from the Health Department.

B. Test samples in accordance with AWWA C601.

C. Quality Assurance: Testing Laboratory: Certified for examination of drinking water in compliance with applicable legislation of the State of Florida.

D. Regulatory Requirements: Conform to Chapter 17-22 of the Florida Administrative Code.

E. Submittals

1. Submit name of testing laboratory and evidence of qualification.

2. Submit three copies of reports.

F. Project Record Documents

1. Submit reports under provisions of Sections entitled “Submittals” and “Project Closeout”.

2. Bacteriological report; accurately record:

a. Date issued, project name, and testing laboratory name, address, and telephone number.

b. Time and date of water sample collection.

c. Name of person collection sample.

d. Test locations.

e. Initial and twenty-four- hour disinfectant residuals in ppm for each outlet tested.

f. Coliform bacteria test results for each outlet tested.

g. Certification that water conforms, or fails to conform to bacterial standards of State of Florida.

h. Bacteriologist's signature.

3.07 CONNECTIONS TO EXISTING SYSTEM

A. Where connections are to be made to an existing potable water system, the interior surfaces of all pipe and fittings used in making the connections shall be swabbed or sprayed with a one percent hypochlorite solution before they are installed. Thorough flushing shall be started as soon as the connection is completed and shall be continued until discolored water is eliminated.

B. Prior to actual connections to the existing potable water system, record drawings, hydrostatic pressure test results, and bacterial test results shall be submitted to the Engineer.

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DIVISION 16

Electrical

SECTION 16035

ACCEPTANCE TESTING AND PERFORMANCE VERIFICATION

PART 1 -- GENERAL

1.01 GENERAL SCOPE

A. The Contractor shall engage the services of a recognized corporately and financially independent testing firm for the purpose of performing inspections and tests on all new electrical equipment supplied in this contract and on existing modified equipment as herein specified. All tests shall be documented. It is the intent of these Specifications that the testing firm work in direct communication with the engineer of record with frequent testing data updates as the work progresses.

B. The testing firm shall provide all material, equipment, labor and technical supervision to perform such tests and inspections. Testing shall be supervised by qualified professional engineering staff.

C. It is the purpose of these tests to assure that all tested electrical equipment, is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications. Tests shall be performed with and in cooperation with certification tests performed by switchgear and generator manufacturer. The testing contractor shall be an integral part in assuring the coordinated testing and startup of the power system. The tests and inspections shall determine suitability for energization.

D. An itemized description of existing equipment (wellfield equipment) to be inspected and tested is as follows:

1. Provide testing of existing feeders that are relocated, extended or disturbed in any way.

2. Provide testing of existing breakers that are re-fed, relocated, re-cabled or disturbed in any way.

E. The above electrical testing shall be used in the development of the final testing report encompassing all new and existing electrical equipment; submitted with the operation and maintenance manuals prior to substantial completion of the project. The testing report shall be submitted on 8.5-inch by 11-inch paper bound with all field test data in appendix form plus an electronic copy in Adobe PDF format. All tested breakers shall be fitted with a sticker indicating the testing firm, date and technician performing the test.

1.02 APPLICABLE CODES, STANDARDS, AND REFERENCES

A. All inspections and test shall be in accordance with the following codes and standards except as provided otherwise herein:

1. National Electrical Manufacturer's Association – NEMA.

2. American Society for Testing and Materials – ASTM.

3. Institute of Electrical and Electronic Engineers – IEEE.

4. International Electrical Testing Association - NETA Acceptance Testing Specifications - ATS-1991.

5. American National Standards Institute - ANSI C2: National Electrical Safety Code.

6. State and local codes and ordinances.

7. Insulated Cable Engineers Association – ICEA.

8. Association of Edison Illuminating Companies – AEIC.

9. Occupational Safety and Health Administration – OSHA.

10. National Fire Protection Association – NFPA.

    a. ANSI/NFPA 70: National Electrical Code.

    b. ANSI/NFPA 70B: Electrical Equipment Maintenance.

    c. NFPA70E: Standard for Electrical Safety in the Workplace.

    d. ANSI/NFPA 780: Lightning Protection Code.

    e. ANSI/NFPA 101: Life Safety Code.

B. All inspections and test shall utilize the following references:

1. Project design Specifications.

2. Project design Drawings.

3. Manufacturer's instruction manuals applicable to each particular apparatus.

1.03 QUALIFICATIONS OF TESTING FIRM

A. The testing firm shall be an independent testing organization which can function as an unbiased testing authority, professionally independent of the manufacturers, supplier, and installers of equipment or systems evaluated by the testing firm.

B. The testing firm shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.

C. The testing firm shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907, or be a Full Member company of the International Electrical Testing Association (NETA).

D. The lead, on-site, technical person shall be currently certified by the International Electrical Testing Association (NETA) or National Institute for Certification in Engineering Technologies (NICET) in electrical power distribution system testing or be a electrical professional engineer in the state of Florida.

E. The testing firm shall utilize engineers and technicians who are regularly employed by the firm for testing services. The testing firm shall provide in house electrical studies and reports as specified. The testing firm shall have a Florida registered professional electrical engineer on staff.

F. The testing firm shall submit proof of the above qualifications when requested. Pre-qualified testing firms for this Project are:

1. Vertiv, Co.

2. Industrial Electrical Testing, Inc.

3. Electric Power Systems.

4. Circuit Breaker Sales & Service.

G. Other firms will be considered by the engineer on submittal of qualifications on or before 20 days prior to Bid.

1.04 DIVISION OF RESPONSIBILITY

A. The Contractor shall perform routine insulation-resistance, continuity, and rotation test for all distribution and utilization equipment prior to and in addition to tests performed by the testing firm specified herein.

B. The Contractor shall supply a suitable and stable source of electrical power to each test Site.

C. The Contractor shall notify the testing firm when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling. However the testing firm shall visit the Site a minimum of once a week to perform coordination duties required and make reports to the engineer of the installation progress.

D. The testing firm shall notify the engineer prior to commencement of any testing.

E. Any system, material, or workmanship which is found defective on the basis of acceptance tests shall be reported to the Engineer.

F. The testing firm shall maintain a written record of all tests and, upon completion of project, shall assemble and certify a final test report.

G. Safety and Precautions:

1. Safety practices shall include, but are not limited to, the following requirements:

a. Occupational Safety and Health Act.

b. Accident Prevention Manual for Industrial Operations, National Safety council.

c. Applicable state and local safety operating procedures.

d. Owner's safety practices.

e. National Fire Protection Association - NFPA 70E-2009.

f. American National Standards for Personnel Protection.

2. All test shall be performed with apparatus de-energized. Exceptions must be thoroughly reviewed to identify safety hazards and devise adequate safeguards.

3. The testing firm shall have a designated safety representative on the project to supervise the testing operations with respect to safety.

1.05 SUITABILITY OF TEST EQUIPMENT

A. All test equipment shall be in good mechanical and electrical condition.

B. Digital multimeters used shall be RMS sensing when the variable be measured contains harmonics or dc offset or any deviation from a pure sine wave. Accuracy of metering in test equipment shall be appropriate for the test being performed but not in excess of 2 percent of the scale used.

PART 2 -- INSPECTION AND TEST PROCEDURES

2.01 SWITCHGEAR, SWITCHBOARD AND PANELBOARD ASSEMBLIES

A. Visual and Mechanical Inspection:

1. Inspect for physical, electrical, and mechanical condition.

2. Compare equipment nameplate information with latest one-line diagram.

3. Check for proper anchorage, required are clearances, physical damage and proper alignment.

4. Inspect all doors, panels, and sections for paint, dents, scratches, fit and missing hardware.

5. Verify that fuse and/or circuit breaker sizes and types correspond to Drawings.

6. Verify that current and potential transformer ratios correspond to drawings. Inspect all bus connections for high resistance.

7. Check tightness of bolted bus joints by using a calibrated torque wrench. Refer to manufacturer's instructions for proper torque levels. Inspect shipping splits for

mechanical connection assuring adequate surface contact.

8. Test all electrical and mechanical interlock systems for proper operation and sequencing. Closure attempt shall be made on locked open devices. Opening attempt shall be made on locked closed devices. Key exchange shall be made with devices operated in off normal positions.

9. Clean entire switchgear using manufacturer's approved methods and materials.

10. Inspect insulators for evidence of physical damage or contaminated surfaces.

11. Verify proper barrier and shutter installation and operation.

12. Lubrication: Verify appropriate contact lubricant on moving current carrying parts. Verify appropriate lubrication on moving and sliding surfaces.

13. Exercise all active components.

14. Inspect all mechanical indicating devices for proper operation.

B. Electrical Tests:

1. Perform tests on all instrument transformers.

2. Perform ground resistance tests.

3. Perform insulation resistance on each bus section, phase-to-phase and phase-to-ground for three (3) minutes. Test voltages and minimum resistances shall be in accordance with NETA recommendations.

4. Perform low ohm resistance test on ground bonding & shipping splits with ductor tester (Digital low ohm resistance meter) to insure connection is a low resistance connection. Test from one fixed bus to adjacent fixed bus through the shipping split connector to measure both connection points. Microhm values shall not vary more than 50 percent from other phase readings and meet the manufactures published data based on bus size, ampacities and material.

5. Perform an overpotential test on each bus section, each phase-to-ground, for three (3) minutes at values indicated in ANSI/IEEE C37.20.2. or manufacturer's recommended potential.

6. Perform insulation-resistance test on control wiring except where connected to solid state components.

7. Perform control wiring performance test. Use the elementary diagrams of the switchgear to identify each remote control and protective device. Conduct tests to verify satisfactory performance of each control feature.

8. Perform secondary voltage energization test on all control power circuits and potential circuits as detailed in this specification. Check voltages levels at each point

on terminal boards and at each terminal on devices.

9. Perform current injection tests on the entire current circuit in each section of switchgear. Perform current test by primary injection where possible; secondary injection if not.

10. Determine accuracy of all meters and calibrate watt-hour meters. Verify multipliers.

11. Perform phasing check on double-ended switchgear to ensure proper bus phasing from each source.

12. Control Power Transformers - Dry Type:

    a. Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.

    b. Verify proper primary and secondary fuse ratings or circuit breakers.

    c. Verify proper interlock function and contact operation.

    d. Perform insulation-resistance test. Perform measurements from winding-to-winding and windings-to-ground.

    e. Perform secondary wiring integrity test. Disconnect transformer at secondary terminals and connect secondary wiring to proper secondary voltage. Check potential at all devices. Verify proper secondary voltage by energizing primary winding with system voltage. Measure secondary voltage with the secondary wiring disconnected.

13. Potential Transformer Circuits:

    a. Perform secondary wiring integrity test. Disconnect transformer at secondary terminals and connect secondary wiring to proper secondary voltage. Check for proper potential at all devices.

    b. Verify secondary voltage by energizing primary winding with system voltage. Measure secondary voltage with the secondary wiring disconnected.

C. Test Values: Verify Bolt-torque values, Insulation resistance, overpotential levels in conformance to NETA standards or specified by manufacturer.

2.02 CABLES - LOW VOLTAGE - 600V MAXIMUM (ALL CABLES EXCEPT 20 AND 30AMP LIGHTING AND RECEPTACLE CIRCUITS).

A. Visual and Mechanical Inspection:

1. Inspect cables for physical damage and proper connection in accordance with Drawings.

2. Test cable mechanical connections to manufacturer's recommended values or NETA Standards using a calibrated torque wrench.

3. Check cable color coding with applicable engineer's specifications and National Electrical Code standards.

B. Electrical Tests:

1. Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 1,000-volts dc for 3 minutes.

2. Perform continuity test to insure proper cable connection.

3. Test Values; Evaluate results by comparison with cables of same length and type. Minimum acceptable value shall be no less than 50 megohms for new feeders; 5megohms for existing reused, renovated, rerouted or extended feeders.

2.03 CIRCUIT BREAKERS (ALL BREAKERS EXCEPT 20AMP LIGHTING AND RECEPTACLE BREAKERS; TEST ALL GFCI BREAKERS)

A. Circuit Breakers - Low Voltage insulated case/molded case:

1. Visual and Mechanical Inspection:

a. Check circuit breaker for proper mounting and compare nameplate data to drawings and specifications.

b. Operate circuit breaker to ensure smooth operation.

c. Inspect case for cracks or other defects.

d. Check tightness of connections using calibrated torque wrench. Refer to manufacturer's instructions or NETA standards for proper torque levels.

2. Electrical Tests:

a. Perform a contact-resistance test.

b. Perform an insulation-resistance test at 1,000-volts dc from pole to pole and from each pole to ground with breaker closed and across open contacts of each phase.

c. Determine long-time minimum pickup current by primary current injection where practical.

d. Perform long-time delay time-current characteristic tests by passing three hundred percent (300%) rated current through each pole separately. Record trip time.

e. Determine short-time pickup and delay by primary current injection, if

applicable.

f. Determine ground-fault pickup and time delay by primary current injection, if applicable.

g. Determine instantaneous pickup current by primary injection using run-up or pulse method.

3. Test Values:

a. Compare contact resistance or millivolt drop values to adjacent poles and similar breakers. Investigate deviations of more than fifty percent (50%). Investigate any value exceeding manufacturer's recommendations.

b. Insulation resistance shall not be less than 100 megohms.

c. Trip characteristic of breakers shall fall within manufacturer's published time-current characteristic tolerance band, including adjustment factors.

d. All trip times shall fall within NETA Standards. Circuit breakers exceeding specified trip time at three hundred percent (300%) of pickup shall be tagged defective.

e. Instantaneous pickup values shall be within NETA standards.

2.04 METERING AND INSTRUMENTATION

A. Visual and Mechanical Inspection:

1. Examine all devices for broken parts, shipping damage and tightness of connections.

2. Verify that meter types, scales and connections are in accordance with Drawings and Specifications.

B. Electrical Tests:

1. Determine accuracy of meters at 25/50/75/100 percent of full scale.

2. Calibrate watt-hour meters to one-half percent (0.5%).

3. Verify all instrument multipliers.

4. Verify calibration of all instrumentation is accurate to the operator interface terminals.

2.05 GROUNDING SYSTEMS: (PROVIDE FOR NEW AND UPGRADED GROUNDING

SYSTEMS)

A. Visual and Mechanical Inspection:

B. Inspect ground systems for compliance with Drawings and Specifications.

C. Perform ground-impedance measurements utilizing the fall-of-potential method per ANSI/IEEE Standard 81 "IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System." Instrumentation utilized shall be as Approved by NETA Standards and shall be specifically designed for ground impedance testing. Provide sufficient spacing so that plotted curves flatten. In large ground grid systems where adequate pole distance is not practical provide Tagg Slope technique or the intersecting curves method (Ref. Nos. 40 and 41 in IEEE Std. 81.) of calculating system resistance.

D. Equipment Grounds: Utilize two-point method of IEEE Standard 81. Measure between equipment ground being tested and known low-impedance grounding electrode of system:

1. Lightning protection ground system test values within the ground system should be 5 ohms or less tested with a clamp on ground test instrument. Down conductor tests at grade level should be 2 ohms or less. Investigate high resistance connections and correct readings above these limits.
2. The main ground electrode system impedance-to-ground should be no greater than one (1) ohms. Equipment grounds, depending on size and length of grounding conductor, should be only fractionally higher than system ground.

2.06 GROUND-FAULT SYSTEMS

A. Visual and Mechanical Inspection:

1. Inspect for physical damage and compliance with Drawings and Specifications.

2. Inspect neutral main bonding connection to assure:

a. Zero-sequence sensing system is grounded.

b. Ground-strap sensing systems are grounded through sensing device.

c. Ground connection is made ahead of neutral disconnect link on zero-sequence sensing systems.

d. Grounded conductor (neutral) is solidly grounded.

3. Inspect control power transformer to ensure adequate capacity for system.

4. Manually operate monitor panels (if present) for: Trip test; No trip test; Non-automatic reset.

5. Record proper operation and test sequence.

6. Set pick-up and time-delay settings in accordance with the settings provided by the manufacturer.

B. Electrical Tests:

1. Measure system neutral insulation resistance to ensure no shunt ground paths exist. Remove neutral-ground disconnect link. Measure neutral insulation resistance and replace link.

2. Determine the relay pickup current by current injection at the sensor and operate the circuit interrupting device.

3. Test the relay timing by injecting three hundred percent (300%) of pickup current, or as specified by manufacturer.

4. Test the system operation at fifty-seven percent (57%) rated control voltage, if applicable.

5. Test zone interlock systems by simultaneous sensor current injection and monitoring zone blocking function.

6. On multiple source, tie breaker, etc., systems, devise a simulation scheme that fully proves correct operation.

C. Test Parameter:

1. System neutral insulation shall be a minimum of one hundred (100) ohms, preferable one (1) megohm or greater.

2. Relay timing shall be in accordance with manufacturer's published time-current characteristic curves but in no case longer than one (1) second for fault currents equal to or greater than 3,000 amperes.

3. Relay pickup value shall be within 10 percent of setting and in no case greater than 1,200A.

2.07 MOTORS (1 hp and Greater)

A. Visual and Mechanical Inspection:

1. Inspect for physical damage.

2. Inspect for proper anchorage, mounting, grounding, connection and lubrication.

3. When applicable, perform special tests as air gap spacing and pedestal alignment.

B. Electrical Tests - Induction Motors:

1. Perform insulation resistance tests in accordance with ANSI/IEEE Standard 43.

2. Motors 200 hp and Less - Test duration shall be for one minute with resistances tabulated at 30 and 60 seconds and calculate the dielectric absorption ratio. Motors larger than 200 hp perform tests for ten minutes and calculate polarization index. Minimum acceptable polarization index for Class B or F insulated motors shall be 2.0.

3. Perform insulation resistance test on pedestal per manufacturer instructions.

4. Perform insulation resistance test on surge protection device in accordance with this Specification.

5. Check that the motor space heater circuit is in proper operating conduction.

6. Check all protective devices in accordance with other sections of these Specifications.

7. Perform a rotation test to ensure proper shaft direction if the motor has been disconnected.

8. Measure running current and evaluate relative to load conditions and nameplate full load amperes. Verify proper overload relays.

2.08 MOTOR CONTROL (ALL MOTORS)

A. Visual and Mechanical Inspection:

1. Inspect for physical damage, proper anchorage, and grounding.

2. Inspect equipment for compliance with drawings and specifications.

3. Motor-running protection

a. Compare overload heater rating with motor full-load current rating to verify proper sizing.

b. If motor-running protection is provided by fuses, verify proper rating considering motor characteristics and power-factor correction capacitors if applicable. Check tightness of bolted connections using calibrated torque wrench.

B. Electrical Tests:

1. Insulation tests:

a. Measure insulation resistance of each bus section phase-to-phase and

phase-to-ground for three (3) minutes. Test voltage shall be in accordance with NETA Standards.

b. Measure insulation resistance of each starter section phase-to-phase and phase-to-ground with the starter contacts closed and the protective device open. Test voltage shall be in accordance with NETA Standards.

c. Measure insulation resistance of each control circuit with respect to ground.

2. Test motor overload units by injecting current through overload unit and monitoring trip time at three hundred percent (300%) of motor full-load current.

3. Three phase power unbalance: Run motor at full load steady state conditions and take current readings on all three leads. Roll the motor leads maintaining the proper rotation and take motor current readings on all three possible hook-ups. Choose the least unbalance hookup for each motor. The maximum acceptable unbalance is 10 percent at full load. If the unbalance cannot be corrected by rolling leads, the source of the unbalance must be located and corrected. If on the three possible hook ups, the leg of "greatest unbalance" (furthest from the average) stays on the same power lead then most of the unbalance is being caused by the power source. However, if the leg of greatest unbalance moves on each of the hookups with a particular motor lead, the primary source of unbalance is on the motor side of the starter. Check for damaged cable, leaking splices, poor connections, or faulty motor winding.

2.09 TRANSFORMERS - DRY TYPE TRANSFORMERS - SMALL DRY TYPE, AIR-COOLED (600 VOLT AND BELOW)

A. Inspect for physical damage, broken insulation, tightness of connections, defective wiring, and general condition.

B. Thoroughly clean unit prior to making any tests.

C. Perform insulation-resistance test. Perform test verification for impedance.

D. Energize primary winding with system voltage. Measure secondary voltage with the secondary load disconnected. Record results.

2.10 THERMOGRAPHIC SURVEY (PROVIDE FOR ALL NEW OR MODIFIED SWITCHGEAR, BUS DUCTS, TRANSFORMERS, POINTS OF POWER CONNECTION EQUAL TO OR GREATER THAN 30AMPS, MCC'S AND DISTRIBUTION CENTERS)

A. Visual and Mechanical:

1. Remove all necessary covers prior to scanning.

2. Inspect for physical, electrical, and mechanical condition.

B. Equipment to be Scanned:

1. All new and existing equipment with ratings of 30 amps or more.

C. Provide report indicating the following:

1. Problem area (location of "hot spot").

2. Temperature rise between "hot spot" and normal or reference area.

3. Cause of heat rise.

4. Phase unbalance, if present.

5. Areas scanned.

D. Test Parameters:

1. Scanning distribution system with ability to detect 1^{o}C between subject area and reference at 30^{o}C.

2. Equipment shall detect emitted radiation and convert detected radiation to visual signal.

3. Infrared surveys should be performed during periods of maximum possible loading but not less than twenty percent (20%) of rated load of the electrical equipment being inspected.

4. Provide photographs and/or the thermogram of the deficient area as seem on the imaging system.

2.11 LOW VOLTAGE SURGE SUPPRESSORS

A. Visual and mechanical inspection:

1. Verify suppressors are installed with minimum length leads to the protected equipment. Verify connections to bus.

2. Verify ground connections to ground bus.

B. Electrical tests:

1. Test clamping voltage and verify meets specified ratings; test in accordance with ANSI C62.33 section 4.4 and 4.7.

2.12 LOW VOLTAGE AIR SWITCHES (DISCONNECT SWITCHES, MANUAL AND AUTOMATIC TRANSFER SWITCHES)

A. Visual and mechanical inspection:

1. Compare equipment nameplate data with drawings and specs.

2. Inspection for mechanical and physical damage. Cleaning of interior, insulators, arc chutes.

3. Testing of mechanical operator. Cleaning and lubrication of contacts and mechanism, as applicable.

4. Verification of contact alignment and wipe. Verify phase barrier insulation.

5. Inspect anchorage, alignment, grounding, and required clearances.

6. Documentation of fuse and types are in accordance with drawings, short circuit studies and coordination study.

7. Verification of tightness of accessible bolted electrical connections by calibrated torque-wrench method.

8. Verification of presence of expulsion-limiting devices on all holders having expulsion-type elements.

9. Verification of interlocking systems for proper operation and sequencing.

10. Verify proper lubrication on current carrying and moving sliding parts.

B. Electrical tests:

1. Contact resistance testing across each switch blade and fuse holder.

2. Measurement of fuse resistance.

3. Insulation resistance testing on each pole, phase-to-phase and phase-to-ground with switch closed and across each open pole for one minute.

4. ac or dc overpotential testing phase-to-phase and phase-to-ground.

5. Verification of proper space heater operation.

-END OF SECTION-

SECTION 16037

SHORT CIRCUIT, COORDINATION AND & ARC FLASH STUDIES

PART 1 – GENERAL

1.01 GENERAL SCOPE

A. Provide the services of a recognized corporately and financially independent firm for the purpose of performing electrical studies and reports on all new electrical equipment supplied in this contract and on existing equipment as herein specified. It is the intent of these specifications that the study firm work in direct communication with the engineer of record with frequent updates as the work progresses. The study firm shall provide all material, equipment, labor and technical supervision required to perform the studies and reports.

B. Provide a short circuit, coordination and arc-flash study for entire electrical system. Provide a single final electrical study report incorporating the short circuit, coordination and arc flash study. The final document shall become part of the operation and maintenance manuals for the facility. The report shall be submitted on 8.5" X 11" paper bound with all field data in appendix form. Drawings within the testing report shall be on 11" X 17" paper folded to 8.5" X 11" and drawn with a computer aided design (CAD) package. The computer aided design package shall be Autocad or converted to Autocad. All adjustable breakers shall be fitted with a sticker indicating the coordination values for the equipment.

C. Provide a short circuit, coordination and arc-flash study from the Generator and Utility Service primary OCP to all points downstream. Provide system studies in latest release of SKM Power Systems software. Provide CD-Rom electronic version of SKM Power Systems software data files bound in study report for future use by owner. The electrical system studies shall be signed and sealed by a Florida registered electrical engineer. All documentation and record drawings shall be verified by the signing engineer. The signing engineer shall meet at the site with the electrical design engineer during the information gathering phase and after system evaluation to discuss remedial changes necessary for code compliance. The remedial work study changes shall be incorporated within the electrical studies at no additional cost to the owner.

1.02 APPLICABLE CODES, STANDARDS, AND REFERENCES

A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems

2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems

3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis

4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings

5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.

6. IEEE 1584 – Guide for Performing Arc-Flash Hazard Calculations

B. American National Standards Institute (ANSI):

1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers

2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures

3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis

4. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories

5. ANSI C37.5 – Methods for Determining the RMS Value of a Sinusoidal Current Wave and Normal-Frequency Recovery Voltage, and for Simplified Calculation of Fault Currents

C. The National Fire Protection Association (NFPA)

1. NFPA 70 - National Electrical Code, latest edition

2. NFPA 70E – Standard for Electrical Safety in the Workplace

1.03 QUALIFICATIONS

A. The study firm shall be regularly engaged in the study of electrical equipment devices, installations, and systems. The lead, technical person shall be a electrical professional engineer in the state of Florida. The study firm shall provide in house electrical studies and reports as specified. The study firm shall submit proof of 5 similar studies with the above qualifications when requested. At least two of the similar project examples shall include arc flash studies with variable frequency drives.

B. Pre-qualified study firms are:

1. Emerson Electrical Reliability Services, Inc. (239)-693-7100

2. Industrial Electrical Testing, Inc. (904) 260-8378

3. Crews Electrical Testing, Inc. (904) 880-8686

Other firms will be considered by the engineer on submittal of qualifications on or before 20 days prior to bid.

PART 2 – PRODUCT

2.01 SHORT-CIRCUIT ANALYSIS AND COORDINATION STUDY for all new electrical equipment. Provide an integrated complete study for the total electrical system.

A. Data Collection: Study Firm shall furnish all field data as required by the power system studies. All data shall be verified on site by the signing engineer. The study firm shall expedite collection of the data to eliminate unnecessary delays and assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

B. Data may require combination to include present and future utility supplies, motors, and generators.

C. Load data utilized may include existing and proposed loads obtained from Contract Documents and site visits.

D. Include fault contribution of existing motors in the study, with motors < 10 hp grouped together. The testing firm shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.02 Provide a current and complete short-circuit study, equipment interrupting or withstand evaluation, and a protective device coordination study for the electrical distribution system.

A. The studies shall include all portions of the electrical distribution system from the normal and alternate sources of power throughout the low-voltage distribution system. Normal system operating method, alternate operation, and operations which could result in maximum fault conditions shall be thoroughly covered in the study.

B. The studies shall be submitted to the project electrical engineer prior to granting final approval of the distribution equipment shop drawings and/or prior to release of equipment for manufacture.

C. The study shall be in accordance with applicable ANSI and IEEE Standards. The study input shall include the utility company's short circuit single and three phase contribution, with the X/R ratio, the resistance and reactance components of each branch impedance, motor and generator contributions, base quantities selected, and all other applicable circuit parameters.

D. Short circuit momentary duties and interrupting duties shall be calculated on the basis of maximum available fault current at each switchgear bus, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboards, and other significant locations through the system.

E. An equipment evaluation study shall be performed to determine the adequacy of new and existing circuit breakers, controllers, surge arresters, busways, switches, and fuses by tabulating and comparing the short circuit ratings of these devices with the available fault currents. Any problem areas or inadequacies in the existing equipment shall be documented back to the project engineer with recommended remedial actions. The study

firm shall coordinate with the supplier of the new equipment to assure all specifications of the new equipment meet or exceed the ratings required by the study at no additional cost to the owner.

F. A protective device coordination study shall be performed to select or to check the selections of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated voltage and current transformers, and low-voltage breaker trip characteristics and settings. The coordination study shall include all voltage classes of equipment from the utility's incoming line protective device down to and including each motor control center and/or panelboard. The phase and ground overcurrent protection shall be included, as well as settings for all other adjustable protective devices.

G. The time current characteristics of the specified protective devices shall be plotted on appropriate log-log paper. The plots shall include complete titles, representative one-line diagram and legends, associated power company's relays of fuse characteristics, significant motor starting characteristics, complete parameters of transformers, complete operating bands of low voltage circuit breaker trip curves, and fuse curves. The coordination plots shall indicate the types of protective devices selected, proposed relay taps, time dial and instantaneous trip settings, ANSI transformer magnetizing inrush and withstand curves per ANSI C37.91, cable damage curves, symmetrical and asymmetrical fault currents. All requirements of the current National Electric Code shall be adhered to. Reasonable coordination intervals and separation of characteristic curves shall be maintained. The coordination plots for phase and ground protective devices shall be provided on a complete system basis. Sufficient curves shall be used to clearly indicate the coordination achieved to each utility main breaker, primary feeder breaker, unit substation primary protective device rated or more. There shall be a maximum of four protective devices per plot.

H. The selection and settings of the protective devices shall be provided separately in a tabulated form listing circuit identification, IEEE device number, current transformer ratios, manufacturer, type, range of adjustment, and recommended settings. A tabulation of the recommended power fuse selection shall be provided for all fuses in the system. Discrepancies, problem areas, or inadequacies shall be coordinated with the equipment suppliers and resolved with in the scope of the project and at no additional cost to the owner.

I. The results of the power system study shall be summarized in a final report and made part of the operation and maintenance manuals. The report shall include the following sections;

1. Description, purpose, basis written scope, and a single line diagram of the portion of the power system which is included within the scope of study.

2. Tabulations of circuit breaker, fuse and other equipment ratings versus calculated short circuit duties, and commentary regarding same.

3. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection and commentary regarding same.

4. Fault current tabulations including a definition of terms and a guide for interpretation.

2.03 The contractors certified study firm shall be responsible for setting the breakers. Each breaker shall be fitted with an engraved tag or permanent vinyl label indicating the breaker name and the settings listed: Adjustable pickups and time delays (long time, short time, ground); Adjustable time-current characteristic; Adjustable instantaneous pickup; Recommendations shall incorporate revised settings to mitigate excessive arc flash hazard.

2.04 ARC FLASH EVALUATION

A. Provide an investigation to quantify the arc-flash hazard to which workers could be exposed to throughout the facility. Establish arc-flash intensity data for all electrical equipment where there may be an occasion to open doors, remove covers or work on the electrical equipment in such a way that workers are exposed to energized conductors.

B. Provide a safety policy to include procedures and information regarding the arc flash data developed for the site. Provide a written recommendation for PPE equipment following the simplified approach to PPE defined in NFPA 70E Annex H. The site safety manual to include procedures and methods related to energized work, PPE standards, and the arc-flash data developed in the analysis.

C. Provide arc flash evaluations in conformance to the latest edition of IEEE Std. 1584- IEEE Guide for Performing Arc-Flash Hazard Calculations and NFPA 70- National Electrical Code and NFPA 70E-Standard for Electrical Safety in the Workplace. The arc flash study shall be performed using computer software that uses methods based on IEEE Std. 1584. The software used must be capable of modeling all protective devices at the site and any mitigation devices used to limit the incident energy. The software used must have the capability of modeling user defined PPE descriptions and ATPV values as well as limiting the maximum clearing time where engineering judgment deems it prudent.

D. The study firm shall collect all data required for the arc flash evaluation. The existing settings and equipment types and ratings shall be field verified. Any data that should be determined to be unverifiable (due to safety or operational concern) shall be identified to the engineer and alternate means to determine the data shall be used.

E. Where the calculations determine that the breaker settings result in arc flash hazard of category three, four or with incident energy levels (>40 cal/cm2), the study engineer shall provide recommended breaker settings or other mitigation recommendations to reduce the incident energy to the lowest level and where energized work is capable of being performed. The study firm shall document the recommended changes and provide time-current curves indicating the coordination that reflects the recommended settings. Where main switchgear incorporates fully compartmentalized breakers and insulated bus, analyze utility main and genset main breaker compartments separate from feeder breaker compartments.

F. Provide color coded labels per ANSI Z535.4; Orange=Warning, Red=Danger. Provide arc flash hazard/risk category 0-2 with an incident energy of 0-8cal/cm2 equipment with Orange “Warning” Labels. Provide arc flash hazard/risk category 3-4 with an incident

energy of 8-40cal/cm2 equipment with Orange “Warning” Labels. Provide Red “Danger” labels with the words “Energized Work Prohibited” in areas of extreme hazard above 40cal/cm2. Provide labels as approved by the engineer consistent with utility standards and in accordance with the simplified PPE approach defined in NFPA 70E, Annex H.

G. Provide permanent labels for each electrical enclosure or equipment where workers could be exposed to energized conductors. Provide die-cut 4" x 6" labels with preprinted headers. Organize safety information in approved order to communicate quickly, clearly and accurately. Provide Die-cut labels made from industrial grade indoor/outdoor vinyl, providing a long label life. Labels shall not include study firm information. Label layout shall be approved by the project engineer. Provide orange Warning and red Danger labels for category 0-2, 3-4 and above incident energy categories. Study firm shall supervise installation of labels and provide a statement in the project report that the labels are approved as installed. These labels shall comply with the requirements of NFPA 70E and include at least the following information:

- Voltage (phase to phase).
- Flash Protection Boundary (inches).
- Incident Energy at the working distance (cal/cm2).
- PPE Class and Description (Including glove rating).
- Restricted Approach Boundary (inches).
- Limited Shock Approach Boundary (inches).
- Prohibited Shock Approach Boundary (inches).
- Location Identification

H. Provide a comprehensive report that includes the basis for and results of numerical assessments. The report shall include any significant conclusions and recommendations for corrective or mitigative action as appropriate. In addition, the report shall include the following:

- Summary of project.
- Description of system and equipment included in the assessment.
- Identification of the methods or software used.
- Date work was performed.
- Identification of the person that performed the assessment.
- Tabular data indicating; the incident energy and required PPE for all locations evaluated.
- Detailed datasheets for each location studied.
- Tabular data of recommended settings changes.
- Time-current curves for the locations with recommended settings changes.

- A one-line diagram of the computer model.

I. Sample Arc Flash Labels:

-END OF SECTION-

SECTION 16040

IDENTIFICATION OF ELECTRICAL SYSTEMS

PART 1 -- GENERAL

1.01 GENERAL

A. Provide materials and installation for the identification of electrical equipment, components, cables and wiring and safety signs.

B. Related Work Specified in Other Sections Includes:

Section 16050-Basic Electrical Materials and Methods; Section 16035 Acceptance Testing; Section 16120 Low Volt. Wires and Cables; Section 16910 Control Panels,

1.02 REFERENCES:

A. Codes and standards incorporated within this Section are:

1. ANSIC2/NFPA70E National Electrical Safety Code (NESC)

2. ANSI Z535.1 Safety Color Code

3. ANSI Z535.2 Environmental and Facility Safety Signs

4. ANSI Z535.3 Criteria for Safety Symbols

5. OSHA Occupational Safety and Health Act: specification 1910.145, Standards for Accident Prevention, Signs and Tags

1.03 SUBMITTALS: Furnish all product submittals used.

A. Product Data and Information: Furnish manufacturer's catalog data for safety signs, nameplates, labels and markers.

B. Furnish manufacturer's instructions indicating application conditions and limitations of use; and storage, handling, protection, examination and installation of product.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS:

A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.

1. W. H. Brady Company

2. Seton

3. Thomas & Betts A.

4. Approved Equal

2.02 MATERIALS

A. General: Provide identification materials listed and classified by UL or tested by an acceptable Electrical Testing Company certifying the equivalence of the materials to UL listing requirements and OSHA approved.

B. Laminated Plastic Nameplates: Provide engraved three layer laminated plastic nameplates with black letters on white background with lettering etched through the outer covering and fastened with corrosion resistant pan head brass or stainless steel machine nuts and bolts. Do not use mounting cement for fastening nameplates.

1. Provide nameplates with 1-inch high lettering for main breakers, automatic transfer switches, panelboards, transformers, VFD's, control panels and disconnect switches.

2. Provide nameplates for each motor identifying service or function and lettering of an appropriate size to suit each motor. Submersible motor nameplates to be affixed to equipment disconnect.

3. Provide approved directories of circuits with typewritten designations of each branch circuit in each panelboard.

4. Provide smaller lettering for a neat, legible nameplate where the amount of lettering causes excessively large nameplates.

2.03 WIRE MARKERS: Identify wire bundles and each individual wire.

A. Wire bundles: Provide a permanent waterproof brass or rigid fiber identifying tag attached with nylon self locking "Ty-Raps".

B. Wire identification markers: Provide a printed white, heat-shrink, seamless tubing type with black bold lettering for wires size No. 10 AWG and smaller. Provide a printed self-laminating white, vinyl type with black bold lettering for wires No. 8 AWG and larger

C. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

D. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

E. Write-On Tags: Polyester tag, 0.015-inch thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable: Marker for Tags: Permanent, waterproof, black-ink marker recommended by tag manufacturer.

2.04 SAFETY SIGNS: Provide safety signs in accordance with OSHA standards meeting the requirements of ANSI C2, ANSI Z535.1 , ANSI Z535.2 and ANSI Z535.3. Comply with NFPA 70 and 29 CFR 1910.145

A. Provide safety signs manufactured from vinyl having a minimum thickness of 60 mils with red and black letters and graphics on a white background.

B. Size: Provide 7-inch by 10-inch signs or smaller if larger size cannot be applied.

C. Mount safety signs using corrosion-resistant screws. Do not use mounting cement.

D. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

E. All receptacles and switches shall be identified on the inside of the cover plate by circuit number and panelboard.

F. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application and with 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.

G. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing, and with colors, legend, and size required for application and with 1/4-inch grommets in corners for mounting. Nominal size, 10 by 14 inches.

2.05 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch. Identification plates shall be furnished for lighting and power panelboards, motor control centers, all line voltage heating and ventilating control panels, fire detector and sprinkler alarms, pilot lights, disconnect switches, manual starting switches, magnetic starters, and all miscellaneous controls, switches and enclosures.

B. Process control devices and pilot lights shall have identification plates. Identification plates shall be furnished for all line-voltage enclosed-circuit breakers; the plates shall identify the equipment served, voltage, phase(s), and power source. Circuits 480 volts and above shall have conspicuously located warning signs in accordance with OSHA requirements.

C. Identification plates shall be three-layer white-black-white, engraved to show black letters on a white background. Letters shall be uppercase. Identification plates 1-1/2 inches high and smaller shall be 1/16 inch thick with engraved lettering 1/8 inch high. Identification plates larger than 1-1/2 inches high shall be 1/8 inch thick with engraved lettering not less than 3/16 inch high. Identification plates having edges of 1-1/2 inches high and larger shall be beveled:

D. Provide nameplates of minimum letter height as follows: Panelboards, switchboards, safety switches and motor control centers: 1/4-inch, identify panel name; 1/8-inch, identify voltage, phase, number of wires, and source.

E. Safety color coding for identification of warning signs shall conform to NEMA Z 535. Red identification plates reading CAUTION: 480/277 VOLTS shall be provided in switch and outlet boxes containing 277-or 480-volt circuits. An identification plate marked DANGER: 480 VOLTS shall be provided on the outside of 480-volt enclosures. Identification plate shall use white lettering on a red laminated plastic.

F. Any equipment with externally powered wiring shall be marked with a laminated plastic name plate having 3/16-inch-high white letters on a red background as follows: DANGER – EXTERNAL VOLTAGE SOURCE.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. General: Install nameplates on the front of equipment, parallel to the equipment lines and secured with corrosion resistant pan head nuts and bolts. Labels to be consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual designations. Warning Labels for Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply metal-backed, butyrate warning signs. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.

B. Install laminated nameplates identifying, each electrical equipment enclosure and Individual equipment and devices. The following items shall be equipped with nameplates: All motors; motor starters, motor-control centers, pushbutton stations, control panels, time switches, disconnect switches panelboards, circuit breakers, contactors, recorders, transmitters, instruments or relays in separate enclosures, thermostats, photocells, power receptacles, switches controlling equipment or receptacles, switches controlling lighting fixtures where the fixtures are not located within the same space as the controlling switch, termination cabinets, manholes and pull boxes, instrumentation and control terminal cabinets, pull boxes manholes and cabinets. Special electrical systems shall be identified at junction and pull boxes, terminal cabinets and equipment racks.

C. Electrical contractor is responsible for nameplates on electrical equipment supplied by other divisions and installed and wired by electrical including all instrumentation and controls equipment. A portion of existing equipment affected by this contract shall also receive nameplates as determined by the engineer.

D. Surface Preparation: Degrease and clean surfaces to receive nameplates, labels and marking paint.

E. Nameplates shall adequately describe the function of the particular equipment involved. Nameplates for panelboards and switchboards shall include the panel designation, voltage and phase of the supply. For example, "Panel A, 277/480V, 3-phase, 4-wire". The name of the machine on the nameplates for a particular machine shall be the same

as the one used on all motor starters, disconnect and P.B. station nameplates for that machine. Equipment Requiring Workspace Clearance shall be labeled According to NFPA 70 applied to door or cover of equipment.

F. Label all disconnects with nameplates as well as the location from which they are fed

G. Rework or reuse of existing equipment will require new identification tags for some existing equipment.

H. Wire Markers: Identify each individual wire with identification tags as follows:

1. Wire identification markers: Provide wire identification markers on each wire at all termination points.

   a. On power and lighting circuits: The branch circuit or feeder number as indicated on drawings

   b. On control circuits terminated in motor control centers, switchgears, control panels and alike: The field device and terminal number of the opposite end connection.

   c. On control circuits at each field device: The panel or compartment number and terminal number of the opposite end connection.

2. Provide oversize wire markers so that after heat shrinking the wire marker can be rotated on the wire. Rotate wire markers so that wire identification number is visible.

3. All wires whether spare or used shall be tagged.

4. Mark wire at both ends.

I. Raceway Tags

1. Provide raceway tags to identify origin and destination of conduit. Install tags at each terminus and at midpoint of run. Provide tags at minimum intervals of every 50 feet of above grade raceway except where concealed in walls. Provide two color hard plastic engraved tags and UV resistant cable ties for attachment.

2. Tag numbers to match that submitted on approved conduit schedule.

J. Safety Signs: Provide safety signs as follows or as shown:

1. Wording: "DANGER -ELECTRICAL EQUIPMENT, AUTHORIZED PERSONNEL ONLY" Location: On the outside door of all electrical equipment rooms or areas. On the outside door of all electrical equipment cabinets.

2. Wording: "DANGER -POWERED FROM MORE THAN ONE SOURCE" Location: Outside all equipment that operates from more than one power source; ATS, PLCs, Main Tie Main switchgear/MCCs, etc.

3. Wording: "NOTICE -KEEP DOOR CLOSED" Location: On all doors with another safety sign installed.

4. Wording: "CAUTION -CONTROLS & INTERLOCKS POWERED FROM MULTIPLE SOURCES". Location: On all control panel doors, MCCs I&C terminal cabinets, etc.

K. Create and submit conduit schedule. Schedule to identify conduit tag numbers, the locations the conduit connects and the wire count.

-END OF SECTION-

SECTION 16050

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 -- GENERAL

1.01 SUMMARY

A. Section Includes: General requirements for providing basic electrical materials and methods.

B. Related Work Specified in Other Sections Includes: Certain items of equipment, and various control devices including conduit and wiring which are indicated on electrical drawings to be connected, but are specified in other sections pertaining to plumbing, heating, ventilating, air conditioning, temperature control systems, process equipment, process control systems, and instrumentation. Install and connect these items to the electrical system as indicated or required in accordance with the Contract Documents.

C. Overall Application of Specifications: This Section applies to all sections of Division 16 and to other sections that include electrical equipment requirements except when in these individual sections requirements are otherwise specified to provide and install all materials necessary for a complete operational system.

D. Temporary Requirements: This Section applies to any temporary circuits, overcurrent devices, conduit, wiring, and other equipment required during changeover from existing to a new electrical system. This Section also applies to temporary rewiring of lighting and power circuits, instruments and devices.

1.02 DEFINITIONS

A. Hazardous Areas: Equipment, materials and installation in areas designated as hazardous on the Drawings shall comply with NEC Articles 500, 501, 502 and 503. Hazardous areas as defined by the NEC as Class I, Division 1, Group D, or Class I, Division 2, Group D; hazardous areas as follows:

1. Class 1, Division 1, Group D

    a. Wet Wells

    b. Pretreatment

2. Class 1, Division 2, Group D

    a. Pump Rooms and Dry Well

    b. Odor control

1.03 SYSTEM DESCRIPTION

A. Design Requirements: Design requirements are specified in the applicable sections.

B. Performance Requirements: Performance requirements are specified in the applicable sections.

1.04 SUBMITTALS

A. General: Provide submittals for all electrical material and devices. Including the following:

1. Submit Technical Information Brochures at start of construction or within 30 days after Award of the Contract. Each brochure shall consists of an adequately sized, hard-cover, 3-ring binder for 8-1/2" X 11" sheets. Provide correct designation on outside cover and on end of brochure. When, in the judgment of the Engineer, one binder is not enough to adequately catalog all data, an additional binder will be required and data split as directed by the Engineer. Specific shop drawing submittals may be submitted separately after technical information brochures but before any equipment is purchased; provide index and schedule of shop drawings to be submitted within the technical information brochures.

2. First sheet in the brochure shall be a photocopy of the Electrical Index pages in these specifications. Second sheet shall be prepared by the Contractor, and shall list Project Addresses and phone numbers with key personnel for this project.

3. Provide reinforced separation sheets tabbed with the appropriate specification reference number.

4. The General Contractor shall review the brochures before submitting to the Engineer. No request for payment will be considered until the brochure has been submitted and reviewed completely.

5. Submit cost breakdown "Schedule of Values" for electrical work in the Technical Information Brochures. Cost of material and labor for each major item shall be shown.

6. Acceptance: When returned to Contractor, submittals will be marked with Engineer's stamp. If box marked "returned for correction resubmit" is checked, submittal is not approved and Contractor is to correct and resubmit as noted, otherwise submittal is approved and Contractor is to comply with notation making necessary corrections on submittal and resubmit for final record.

7. Note that the approval of shop drawings, or other information submitted in accordance with the requirements hereinbefore specified, does not assure that the Engineer, or any other Owner's Representative, attests to the dimensional accuracy or dimensional suitability of the material or equipment involved, the ability of the material or equipment involved or the Mechanical/Electrical performance of equipment. Approval of shop drawings does not invalidate the plans and specifications if in conflict with the submittal. It is the contractor’s responsibility to request in writing and seek written approval from the engineer for all deviations of the plans and specifications.

B. Product Data and Information: Provide complete list of electrical equipment and materials to be furnished showing manufacturer, catalog number, size, type, voltage rating and other pertinent information.

1. Provide catalog data on manufacturer's standard equipment and materials. Clearly indicate on catalog cuts the equipment and devices being proposed.

2. Identification: Provide complete schedule and listing of system and equipment identification labels with legends.

3. Material shall not be ordered or shipped until the shop drawings have been approved.

4. The Engineer's shop drawing review shall be for conformance with the design concept of the project and compliance with the Specifications and the Drawings. Errors and omissions on approved shop drawings shall not relieve the Contractor from the responsibility of providing materials and workmanship required by the Specifications and the Drawings.

5. Shop drawings shall be stamped with the date checked by the contractor and a statement indicating that the shop drawings conform to the Specifications and the Drawings. This statement shall also list all exceptions to the Specifications and the Drawings. Shop drawings not so checked and noted shall be returned.

C. CONTRACTOR's Shop Drawings: Provide shop drawings on items manufactured for the Contract.

1. Provide connection diagram and schematic for each piece of electrical equipment. A manufacturer's standard connection diagram or schematic showing more than one method of connection is not acceptable unless it is clearly marked to show the intended method of connection.

2. Provide diagrams showing connections to field equipment. Clearly differentiate between manufacturer's wiring and field wiring.

3. Provide raceway layout drawings showing conduits, boxes, and panels which contain the conductors to be provided. Include schedules listing conduit sizes and conductor content and identification.

4. Where additions and modifications are made to existing equipment, provide drawings which include both retained existing equipment and new Work.

D. Coordination Drawings: Prepare to scale coordination drawings (1/4"=1'-0"); detailing major elements, components, and systems of electrical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including but not necessarily limited to the following:

1. Indicate the proposed locations of major raceway systems, equipment, and materials. All dimensions shall be field verified at the job site and coordinated with the work of all other trades. Include the following:

    a. Clearances for servicing equipment, including space for equipment disassembly required for periodic maintenance.

    b. Exterior wall and foundation penetrations.

    c. Fire-rated wall and floor penetrations.

    d. Equipment connections and support details.

    e. Sizes and location of required concrete pads and bases.

E. Record Documents: Prepare record documents, and in addition to the requirements specified in Division 1. As the work progresses, legibly record all field changes on a set of Project Contract Drawings, (the "Record Drawings"). Indicate installed conditions for:

1. Major raceway systems, size and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.

2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.

3. Approved substitutions, and actual equipment and materials installed.

4. Record Drawings shall accurately show the installed condition of the following items: Power Riser Diagram(s). Equipment elevations (front views). Raceways and pullboxes. Conductor sizes and conduit fills. Control Wiring Diagram(s). Underground raceway and duct bank routing. Plan view, sizes and locations of distribution transformers and outdoor electrical equipment enclosure.

5. Submit a schedule of control wiring raceways and wire numbers, including the following information: Circuit origin, destination and wire numbers. Field wiring terminal strip names and numbers.

6. In addition to the schedule, provide point to point connection diagrams showing the same information submitted in the schedule of control wiring raceways including all designations and wire numbers. Comply with PLC tag designation on all instrumentation and control cabling in and out of PLC racks.

7. The schedule of control wiring raceways and wire numbers and the point to point connection diagrams shall be in electronic Autocad and Word format (i.e. no hand-written or drawn schedules, drawings, or diagrams will be accepted)

F. Operation and Maintenance Manuals: Prepare operation and maintenance manuals, and in addition to the requirements specified in other Divisions, include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and catalog numbers of replacement parts. Complete parts list with stock numbers, including spare parts. A complete bill of material supplied, including serial numbers, ranges and pertinent data.

2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions. The operating instructions shall also incorporate a functional description of the entire system, with references to the systems schematic drawings and instructions.

3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

4. A comprehensive index.

5. A complete "As Built" set of approved shop drawings.

6. A table listing of the "as left" settings for all timing relays and alarm and trip setpoints. A complete listing of As left programmable parameters for all drives, soft-starters and other microprocessor controlled equipment.

7. System schematic drawings "As Built", illustrating all components, piping and electric connections of the systems supplied under this Section.

1.05 QUALITY ASSURANCE

A. Codes: Provide all electrical Work in accordance with applicable local codes, regulations and ordinances. If there is a conflict between the requirements specified in the Contract Documents and the codes, follow the more stringent requirements as determined and approved.

B. Testing: As a minimum, provide standard factory and field tests for each type of equipment. Other tests may be specified in the applicable equipment section.

C. Labeling: Provide all electrical equipment and materials listed and approved by Underwriters Laboratories with the UL label or other OSHA recognized testing laboratories attached to it.

D. Standard Products: Unless otherwise indicated, provide electrical materials and equipment which are the standard products of manufacturers regularly engaged in the production of such materials and equipment. Provide the manufacturer's latest standard design that conforms to these Specifications. When two or more units of the same class of material and equipment are required, provide the products of the same manufacturer.

1.06 DELIVERY, STORAGE AND HANDLING

A. General: Deliver, store and handle all products and materials as specified in Division 1 and as follows:

B. Shipping and Packing: Provide materials and equipment suitably boxed, crated or otherwise completely enclosed and protected during shipment, handling, and storage. Clearly label such boxes, crates or enclosures with manufacturer's name, and name of material or equipment enclosed.

C. Acceptance at Site: Conform to acceptance requirements as required in Division 1. Repair or replace all materials and equipment damaged by handling and storage as directed at no additional Contract cost.

D. Storage and Protection: Protect materials and equipment from exposure to the elements and keep them dry at all times. Handle and store to prevent damage and deterioration in accordance with manufacturer's recommendations.

1.07 PROJECT CONDITIONS

A. General: The Drawings indicate the extent and general arrangement of the principal electrical elements, outlets and circuit layouts. Connect and install all electrical elements and devices to form a workable system as required by the Contract Documents whether the connections and installations are specifically stated in the Specifications or shown. Provide necessary materials and installation wherever required to conform to the specific requirements of the furnished equipment and for proper installation of the Work.

B. Schematics: In general the runs of feeders are shown schematically and are not intended to show exact routing and locations of raceways. Verify actual and final arrangement, equipment locations, and prepare circuit and raceway layouts before ordering materials and equipment. Equipment locations are approximate and are subject to modifications as determined by equipment dimensions.

C. Coordination of Work: Coordinate the Work so that the electrical equipment may be installed without altering building components, other equipment or installations.

D. Coordinate arrangement, mounting, and support of electrical equipment:To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated. To provide for ease of disconnecting the equipment with minimum interference to other installations. To allow the right of way for piping and conduit installed at the required slope. To clear connecting raceways, cables, wireways, cable trays, and busways of obstructions and of the working and access space of other equipment. Coordinate the installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed. Coordinate electrical testing of electrical, mechanical, and architectural items, so that functionally interdependent equipment and systems demonstrate successful interoperability.

E. Departure from Design: If departures are deemed necessary due to structural conditions, obstructions or other problems, provide details of such departures and the reasons for requesting approval as soon as practicable but not later than the submittal of the raceway layout drawings. Do not make any departures without written approval.

PART 2 -- PRODUCTS

2.01 FLOOR MATING

A. Provide rubber insulation mats on floor in front of electrical equipment extending 18" beyound. Mats to be minimum 3 feet wide or equal to isle width. Provide OSHA approved insulating mats meeting OSHA regulation 1910.137 with 30,000 volt insulating strength (Matworks or equal, 800 336-4604).

PART 3 -- EXECUTION

3.01 ROUGH-IN

A. Final Location: Verify final locations for rough-ins with field measurements, vendor shop drawings and with the requirements of the actual equipment to be connected.

B. The Drawings are not intended to show exact locations of conduit runs. Coordinate the conduit installation with other trades and the actual supplied equipment.

C. Install each 3 phase circuit in a separate conduit unless otherwise shown.

D. Except where dimensions are shown, the locations of equipment, fixtures, outlets and similar devices shown on the Drawings are approximate only. Exact locations shall be determined by the Contractor and approved by the Engineer during construction. Obtain information relevant to the placing of electrical work and in case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.

E. Surface mounted panel boxes, junction boxes, conduit, etc., shall be supported by spacers to provide a clearance between wall and equipment.

F. All floor mounted electrical equipment shall be placed on 4-inch thick (3/4-inch, 45 degree chamfer at all exposed edges) concrete pads, provide reinforcement, anchors, etc.

G. All "LB" type fitting hardware to be stainless steel or brass. All junction box hardware to be aluminum or stainless steel only.

3.02 ELECTRICAL INSTALLATIONS

A. Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate electrical systems, equipment, and materials installation with other building components.

2. Verify all dimensions by field measurements. Investigate each space in the structure through which equipment must pass to reach its final location. Coordinate shipping splits with the manufacturer to permit safe handling and passage through restricted areas in the structure.

3. The equipment shall be kept upright at all times during storage and handling. When equipment must be tilted for passage through restricted areas, brace the equipment to ensure that the tilting does not impair the functional integrity of the equipment.

4. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.

5. Coordinate the installation of required supporting devices and sleeves to be set in cast-in-place concrete and other structural components, as they are constructed.

6. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.

7. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

8. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

9. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the ENGINEER for resolution.

10. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

11. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

12. Install access panel or doors where units are concealed behind finished surfaces.

13. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.03 CUTTING AND PATCHING

A. Perform cutting and patching as specified in Division 1. In addition to the requirements specified in Division 1, the following requirements apply:

1. Perform cutting, fitting, and patching of electrical equipment and materials required to:

   a. Uncover Work to provide for installation of ill-timed Work.

   b. Remove and replace defective Work.

   c. Remove and replace Work not conforming to requirements of the Contract Documents.

   d. Remove samples of installed Work as specified for testing.

   e. Install equipment and materials in existing structures.

   f. Locate existing structural reinforcing where core drilled penetrations are required so as not to cut the steel reinforcing.

2. Cut, remove, and properly dispose of selected electrical equipment, components, and materials as indicated, including but not limited to removal of electrical items indicated to be removed and items made obsolete by the new Work. Deliver all the existing removed to the OWNER as directed.

3. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

4. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

5. Protection of Installed Work: During cutting and patching operations, protect adjacent installations. Patch finished surfaces and building components using new materials as specified for the original installation and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

-END OF SECTION-

SECTION 16051

SPECIAL ELECTRICAL REQUIREMENTS

PART 1 -- GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install complete and make operational, electrical and process instrumentation systems for the Lee County Utilities Department as shown on the Drawings and as specified herein.

B. The work shall include furnishing, installing and testing the equipment and materials specified in other Sections of the Specifications and shown on the Drawings.

C. It is the intent of these Specifications that the electrical system shall be suitable in every way for the service required. All material and all work which may be reasonably implied as being incidental to the work of this Section shall be furnished at no extra cost. The work shall include but not be limited to furnishing and installing the following:

1. Furnish and install new class 1 reliable Motor Control Center.
2. Modification of existing Switchgear as detailed in Contract specifications.
3. Furnish and install Concrete encased ductbank and conduit racking system for power and fiber distribution.
4. Selective demolition of existing electrical service distribution equipment.
5. Conduit, wire and field connections for all motors, motor controllers, control devices, control panels and electrical equipment furnished under other Divisions of these specifications.
6. Power wiring for all heating, ventilating, and air conditioning (HVAC) equipment furnished under other divisions of the specifications, including power wiring for 120 volt motors, thermostats, fan motors, dampers and other HVAC in line unit wiring.
7. Furnish and install precast handholes. Furnish and install manhole and handhole frames and covers.
8. Provide a complete grounding system and special grounds as required or noted.
9. Provide Power and signal Surge Suppression systems.
10. Provide Concrete work for pad mounted equipment.
11. Provide Instrumentation and control conduit and wiring systems.
12. Provide complete Arc Flash evaluation, short circuit and coordination study and Electrical testing of equipment including SKM file of approved studies.
13. Provide Lightning protection, bonding and grounding systems.
14. Provide complete set of electronic and hard copy project record drawings and Vendor Operation and Maintenance manuals.
15. Provide detailed training sessions.
16. Provide Acceptance Testing of Electrical Equipment.

D. Each bidder or their authorized representatives shall, before preparing their proposal, visit all areas of the existing site and structures in which work under this Division is to be performed and inspect carefully the present installation. The submission of the proposal by this bidder shall be considered evidence that their representative has visited the site and structures and noted the locations and conditions under which the work will be

performed and that the bidder takes full responsibility for a complete knowledge of all factors governing the work.

E. Field verify all existing underground electrical and mechanical piping.

F. The Contractor shall prepare and furnish electrical and instrumentation conduit layout shop drawings for yard electrical, within and under all roads, buildings and structures to the Engineer for approval prior to commencing work. Layouts shall include but not be limited to equipment, pull boxes, conduit routing, dimensioning, methods and locations of supports, reinforcing, encasement, materials, conduit sizing, equipment access, potential conflicts, building and yard lighting, and all other pertinent technical specifications for all electrical and instrumentation conduits and equipment to be furnished. All layouts shall be drawn to scale on 22 x 34 sheets

G. The work shall include complete testing of all equipment and wiring at the completion of work and making any minor correction changes or adjustments necessary for the proper functioning of the system and equipment. All workmanship shall be of the highest quality; substandard work will be rejected.

H. A single manufacturer shall provide panelboards, main breakers, transformers, disconnect switches, etc.

I. Contractor shall provide their own temporary power for miscellaneous power (drills, pumps, etc.). No facility circuits shall be used unless approved by the engineer. Any temporary added shall be removed at job completion.

J. Complete coordination with other contractors. Contractor shall coordinate with all other contractors equipment submittals and obtain all relevant submittals.

K. Mount transmitters, process instruments, operator's stations, etc. furnished under other Divisions of these specifications.

L. Concrete electrical duct encasement, including but not limited to excavation, concrete, conduit, reinforcement, backfilling, grading and seeding is included. Excavation, bedding material, forms, concrete and backfill for underground raceways; forms and concrete for electrical equipment furnished herein is included in this Division.

1.02 QUALIFICATIONS

A. The electrical contractor shall have regularly engaged in the installation of industrial electrical power systems for a minimum period of ten (10) years. When requested by the engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

B. Provide a field superintendent who has had a minimum of ten (10) years previous successful experience on projects of comparable size and complexity. Superintendent shall be present at all times that work under this Division is being installed or affected. A resume of the Superintendent's experience shall be submitted to Engineer before starting work.

1.03 RELATED WORK

A. Excavation and backfilling, including gravel or sand bedding for underground electrical work is specified in other Divisions.

B. Cast in place concrete work, including concrete encasements for electrical duct banks, equipment pads, and reinforcing steel, is specified in other Divisions.

1.04 REFERENCE STANDARDS

A. Electric equipment, materials and installation shall comply with the latest edition of National Electrical Code (NEC) and with the latest edition of the following codes and standards:

1. National Electrical Safety Code (NESC)

2. Occupational Safety and Health Administration (OSHA)

3. National Fire Protection Association (NFPA)

4. National Electrical Manufacturers Association (NEMA)

5. American National Standards Institute (ANSI)

6. Insulated Cable Engineers Association (ICEA)

7. Instrument Society of America (ISA)

8. Underwriters Laboratories (UL)

9. Factory Mutual (FM)

10. International Electrical Testing Association (NETA)

11. Institute of Electrical and Electronic Engineers (IEEE)

12. American Society for Testing and Materials (ASTM)

13. Electrical Safety in the Workplace (NFPA70E-2009)

14. State and Local Codes and Ordinances

B. All electrical equipment and materials shall be listed by Underwriter's Laboratories, Inc., and shall bear the appropriate UL listing mark or classification marking. Equipment, materials, etc. utilized not bearing a UL certification shall be field or factory UL certified prior to equipment acceptance and use. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 ENCLOSURE TYPES

A. Unless otherwise specified herein or shown on the Drawings, electrical enclosures shall have the following ratings:

1. NEMA 12 continuous hinge, 3 point latch for dry, non process indoor locations.

2. NEMA 4X 316 SS, powder coated white continuous hinge, 3 point latch, screw down door clamps for all outdoor locations, rooms below grade (buried vaults), "DAMP" and "WET" locations.

3. NEMA 4X 316 SS, powder coated white continuous hinge, 3 point latch, screw down door clamps for "CORROSIVE" locations.

4. NEMA 7 (and listed for use in the area classifications shown) for "Class I Division 1 Group D", "Class I Division 2 Group D" and "Class II Division 1" hazardous locations shown on the Drawings.

B. Unless otherwise specified herein or shown on the Drawings, junction boxes shall have the following ratings:

1. NEMA rating as applicable and specified above.

2. Have continuous hinge with quick connect door clamp. Flush mounted screw down fronts are not acceptable.

1.06 CODES, INSPECTION AND FEES

A. Equipment, materials and installation shall comply with the requirements of the local authority having jurisdiction. Completed electrical installation shall be inspected and certified by all applicable agencies that it is in compliance with all codes.

B. Obtain all necessary permits and pay all fees required for permits and inspections.

1.07 TESTS AND SETTINGS

A. Test systems and equipment furnished under Division 16 and other divisions supplying electrical equipment. Repair or replace all defective work and equipment. Refer to section 16035 and the individual equipment sections for additional specific testing requirements.

B. Make adjustments to the systems and instruct the Owner's personnel in the proper operation of the systems.

C. In addition to the specific testing requirements listed in section 16035 and the individual Sections, the following minimum tests and settings shall be performed. Submit test reports upon completion of testing in accordance with Section 16035.

1. Mechanical inspection, testing and settings of circuit breakers, disconnect switches, motor starters, overload relays, control circuits and equipment for proper operation.

2. Check the full load current draw of each motor. Where power factor correction capacitors are provided the capacitor shall be in the circuit at the time of the

measurement. Check ampere rating of thermal overloads for motors and submit a typed record to the Engineer of the same, including driven load designation, motor service factor, horsepower, and Code letter. If incorrect thermal overloads are installed replace same with the correct size overload.

3. Check power and control power fuse ratings. Replace fuses if they are found to be of the incorrect size.

4. Check settings of the motor circuit protectors. Adjust settings to lowest setting that will allow the motor to be started when under load conditions.

5. Check motor nameplates for correct phase and voltage. Check bearings for proper lubrication.

6. Check rotation of motors prior to testing the driven load. Disconnect the driven equipment if damage could occur due to wrong rotation. If the rotation is incorrect for the driven equipment correct motor connections at the motor terminal box.

7. Check interlocking, control and instrument wiring for each system and/or part of a system to prove that the system will function properly as indicated by control schematic and wiring diagrams.

8. Inspect each piece of equipment in areas designated as HAZARDOUS to ensure that equipment of proper rating is installed.

9. Verify all terminations at transformers, equipment, panels and enclosures by producing a 1, 2, 3 rotation on a phase sequenced motor when connected to "A", "B" and "C" phases.

10. Check all wire and cable terminations. Verify to the Engineer connections meet the equipments torque requirements.

11. Field set all transformer taps as required to obtain the proper secondary voltage.

12. Infra red hot spot inspection shall be made of all electrical equipment including but not limited to switchgear, motor control centers, transformers, switches, power and control panels, etc. This shall be done under representative load conditions before the equipment is used by the Owner.

1.08 PHASE BALANCING

A. The Drawings do not attempt to balance the electrical loads across the phases. Circuits on panelboards shall be field connected to result in evenly balanced loads across all phases.

B. Field balancing of circuits shall not alter the conductor color coding requirements as specified herein.

1.09 EQUIPMENT IDENTIFICATION

A. Identify equipment (disconnect switches, control stations, etc) furnished under Division 16 with the name of the equipment it serves. Control panels, panelboards, main breakers, junction or terminal boxes, etc, shall have nameplate designations as shown on the Drawings. Nameplates shall adequately describe the function of the particular equipment involved. Where nameplates are detailed on the drawings, inscription and size of letters shall be as shown and shop drawing submitted for approval. Nameplates for panelboards and switchboards shall include the panel designation, voltage and phase of the supply. For example, "Panel A, 277/480V, 3-phase, 4-wire". The name of the machine on the nameplates for a particular machine shall be the same as the one used on all motor starters, disconnect and P.B. station nameplates for that machine.

B. Nameplates shall be engraved, laminated plastic, not less than 1/16 in thick by 3/4 in by 2 1/2 in with 3/16 in high black letters on a white background. Attach with pan head brass or machine type nuts and bolts.

C. Electrical systems shall be identified at junction and pull boxes, terminal cabinets and equipment racks. Electrical contractor is responsible for nameplates on electrical equipment supplied by other divisions and installed and wired by electrical including all instrumentation and controls equipment. A portion of existing equipment affected by this contract shall also receive nameplates as determined by the Engineer.

D. Nameplates shall be screw mounted to NEMA 1 enclosures. Nameplates shall be bonded to all other enclosure types using an epoxy or similar permanent waterproof adhesive. Two sided foam adhesive tape is not acceptable. Where the equipment size does not have space for mounting a nameplate, the nameplate shall be permanently fastened to the adjacent mounting surface. Cemented nameplates shall not be drilled.

E. All voltages (e.g. 480 volts, 240 volts, etc.) within pull boxes, junction boxes etc. shall be identified on the front exterior cover. Signs shall be red background with white engraved lettering, lettering shall be a minimum of 1" high.

F. All receptacles, wall switches, lighting fixtures, photo cells, emergency lights, exit lights, etc. shall be identified with the panel and circuit to which it is connected. Identification shall be with machine generated labels with ¼" high letters.

1.10 SAFETY REQUIREMENTS

A. The Contractor shall make every effort to keep all employees and/or subcontractors aware of the danger inherent in working in dangerous proximity to the existing power lines. The minimum recommended precautionary measures are as follows:

1. Make sure that all persons responsible for operating cranes, draglines and other mobile equipment have a copy of, and are familiar with the State Department of Commerce Regulations for Use of Cranes, Draglines and Similar Equipment Near Power Lines, as well as the U.S. Department of Labor OSHA Regulations, before commencing operation of said equipment.

2. Make sure that all cranes, draglines and other mobile equipment have attached to them the black and yellow Department of Commerce warning signs required by the said Regulations of State Department of Commerce.

3. Warn all employees on the ground, new and old employees alike, of the danger of holding on to or touching a cable or other piece of equipment or machinery that is located or working close to any overhead power line.

4. If, during the course of construction, it becomes necessary for the contractor, or subcontractor, and their employees, to operate cranes, draglines, or their mobile equipment, in dangerous proximity of any overhead power lines, or in such a manner that such equipment might come close to any overhead power lines, the Contractor shall give the Power Company or overhead power line owner prior notice of such proposed operation.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.01 SLEEVES AND FORMS FOR OPENINGS

A. Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc. Locate all necessary slots for electrical work and form before concrete is poured.

B. Exact locations are required for stubbing up and terminating concealed conduit. Obtain shop drawings and templates from equipment vendors or other subcontractors and locate the concealed conduit before the floor slab is poured.

C. Where setting drawings are not available in time to avoid delay in scheduled floor slab pours, the Engineer may allow the installations of such conduit to be exposed. Requests for this deviation must be submitted in writing. No additional compensation for such change will be allowed.

D. Seal all openings, sleeves, penetration and slots as specified in Section 16110.

3.02 INSTALLATION

A. Any work not installed according to the Drawings and this Division or without approval by the Engineer shall be subject to change as directed by the Engineer. No extra compensation will be allowed for making these changes.

B. Electrical equipment shall at all times during construction be adequately protected against mechanical injury or damage by water. Electrical equipment shall not be stored out of doors. Electrical equipment shall be stored in dry permanent shelters. If an apparatus has been damaged, such damage shall be repaired at no additional cost. If any apparatus has been subject to possible injury by water, it shall be replaced at no additional cost to the Owner, the damaged unit(s) or systems shall remain on site and returned to the manufacturer after the replacement unit(s) or systems have been delivered to the site. Under no circumstances will electrical equipment damaged by water be rehabilitated or repaired, new equipment shall be supplied and all cost associated with replacement shall be borne by the Contractor.

C. Equipment that has been damaged shall be replaced or repaired by the equipment manufacturer, at the Engineer's discretion.

D. Repaint any damage to factory applied paint finish using touch up paint furnished by the equipment manufacturer. The entire damaged panel or section shall be repainted per the field painting requirements Section 09902, at no additional cost to the Owner.

A. All “LB” type fitting hardware to be stainless steel or brass. All junction box hardware to be aluminum or stainless steel only.

3.03 MANUFACTURERS SERVICE

A. Provide manufacturer's services for testing and start up of all major electrical equipment: VFDs, ATS, Gensets, MCCs, Switchboards, Switchgear, Etc.

B. Testing and startup shall not be combined with training. Testing and start up time shall not be used for manufacturers warranty repairs.

C. The manufacturers of the above listed equipment shall provide experienced Field Service Engineer to accomplish the following tasks:

1. The equipment shall be visually inspected upon completion of installation and prior to energization to assure that wiring is correct, interconnection complete and the installation is in compliance with the manufacturer's criteria. Documentation shall be reviewed to assure that all Drawings, operation and maintenance manuals, parts list and other data required to check out and sustain equipment operation is available on-site. Documentation shall be red lined to reflect any changes or modifications made during the installation so that the "as built" equipment configuration will be correctly defined. Spare parts shall be inventoried to assure correct type and quantity.

2. The Field Service Engineers shall provide engineering support during the energization and check out of each major equipment assembly. They shall perform any calibration or adjustment required for the equipment to meet the manufacturer's performance specifications.

3. Upon satisfactory completion of equipment test, they shall provide engineering support of system tests to be performed in accordance with manufacturer's test specifications.

4. A final report shall be written and submitted to the Contractor within fourteen days from completion of final system testing. The report shall document the inspection and test activity, define any open problems and recommend remedial action. The reports after review by the Contractor shall be submitted to the Engineer.

3.04 TRAINING

A. The cost of training programs to be conducted with Owner's personnel shall be included in the Contract Price. The training and instruction, insofar as practicable, shall be directly related to the system being supplied.

B. Provide detailed O&M manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project.

C. The training program shall represent a comprehensive program covering all aspects of the operation and maintenance including trouble-shooting of each system.

D. All training schedules shall be coordinated with and at the convenience of the Owner. Shift training may be required to correspond to the Owner's working schedule. The training shall be conducted with record "as built" drawings sufficient for each class member.

E. The Contractor shall submit an overview of the proposed training plan. This overview shall include, for each course proposed:

1. An overview of the training plan.

2. Course title and objectives.

3. Recommended types of attendees.

4. Course Content A topical outline.

5. Course Format Lecture, laboratory demonstration, etc.

6. Schedule of training courses including dates, duration and locations of each class.

3.05 The work under this Division shall include a two-year warranty. This warranty shall be by the Contractor to the Owner for any defective workmanship or material that has been furnished under this Contract at no cost to the Owner for a period of two years from the date of substantial completion of the System. This guarantee shall not include light bulbs or batteries in service after six months from date of Substantial Completion of the System.

-END OF SECTION-

SECTION 16110

CONDUIT SYSTEMS

PART 1 -- GENERAL

1.01 DESCRIPTION

A. Description of System: This Section includes requirements for raceways, fittings, boxes, enclosures, and cabinets for electrical, instrumentation and control system wiring.

B. Heavy wall PVC (Schedule 80) shall be used for all raceways trapped underground without concrete encasement protection. Conduits in concrete encasement use Schedule 40-PVC. Above ground in areas subject to chemical degradation (chemical storage, chlorine rooms, odor control and scrubber area, etc) use Schedule 80-PVC. Use rigid aluminum conduit for exposed above grade interior area. Electrical Metallic Tubing shall be used within air conditioned electrical rooms for power and for instrumentation and control conduits. Use rigid aluminum conduit above grade on exterior of buildings.

C. Minimum conduit size for all systems shall be 3/4". All conduits shall be U.L. listed and labeled. Conduit sizes shown on the drawings are to aid the contractor in bidding only; the contractor is responsible for conduit sizes as required by NEC fill tables but do not provide smaller conduits than indicated. The contractor is responsible to coordinate the required conduit sizes and conductor quantities for all control and instrumentation system conduit and wiring with the controls subcontractor prior to installation. Where PVC conduit penetrates a floor from underground or in a slab; a black mastic coated rigid aluminum conduit elbow shall be used for all conduits.

D. Provide stainless steel or non-metallic conduit supports and 316 stainless steel hardware in all areas.

1.02 SUBMITTALS

A. Product Data:

1. Product data shall be submitted on:

a. Conduit, raceways, wireways.

b. Conduit fittings, boxes, enclosures and cabinets.

c. Surface metal raceway

d. Conduit Schedule identifying conduit tag numbers, locations the conduit connects and the wire count.

PART 2 -- PRODUCTS

2.01 ELECTRIC METALLIC TUBING

A. Electric metallic tubing (thin wall) shall meet Federal EMT Specifications WW-C 563 ANSI C80.3.

2.03 FLEXIBLE CONDUIT

A. Flexible, Nonmetallic, Liquid-Tight Conduit: Type B

1. Material: PVC core with fused flexible PVC jacket. UL 1660 listed for:

a. Dry Conditions: 80 degrees C insulated conductors.

b. Wet Conditions: 60 degrees C insulated conductors.

2. Manufacturers and Products:

a. Carlon; Carflex or X Flex.;

b T & B; Xtraflex LTC or EFC.

2.04 PVC CONDUIT

A. PVC conduit shall be composed of High Impact Virgin homopolymer, PVC (polyvinyl chloride C 200 Compound), and shall conform to industry standards, and be UL 651 listed in accordance with Article 347 of National Electrical Code for underground and exposed use and NEMA standard TC-2. Materials must have tensile strength of 55 PSI, at 70oF, flexural strength of 11,000 PSI, compression strength of 8600 PSI. Manufacturer shall have five years' extruding PVC experience. Consistent with requirements provide PVC conduit products by one of the following manufacturers:

1. Carlon

2. Cantex

3. J.M. Plastics

4. Queen City Plastics

2.05 RIGID ALUMINUM CONDUIT

A. Provide Rigid Aluminum Conduit of 6063 alloy in temper designation T-1. The fittings are of the same alloy. Provide threaded Rigid Aluminum Conduit to Underwriters Laboratories U.L. 6A, “Standard for Electrical Rigid Metal Conduit and manufactured to ANSI C80.5.

B. Provide threaded aluminum conduit fittings, of 6063 alloy, cast aluminum with integral insulated throat as manufactured by Allied, OZ Gedney, T&B, Crouse-Hinds, Killark or Appleton.

C. Provide supplementary corrosion protection for aluminum conduit imbedded in concrete or in contact with soil. Where aluminum conduits are in contact with or penetrate concrete, coast conduit with asphaltic or bitumastic type coating.

2.06 CONDUIT FITTINGS

A. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

B. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.

C. Fittings for EMT: Steel compression type.

D. Fittings, surface boxes and conduit bodies for Rigid Aluminum Conduit shall be heavy cast aluminum with external raised hubs and mounting lugs;- Appleton, Crouse Hinds or approved substitution. Cover plates cast aluminum. Zinc die cast not acceptable.

E. Conduit locknuts shall be aluminum throughout except steel is acceptable within air conditioned spaces.

F. Conduit expansion fittings shall be malleable iron, and shall be hot dipped galvanized inside and outside. These fittings shall have a four-inch expansion chamber to allow approximately two-inch movement parallel to conduit run in either direction from normal. They shall have factory-installed packing and internal tinned copper braid packing to serve as an emergency bonding jumper. Unless the fitting used is listed by Underwriters' Laboratories for use "without external bonding jumpers", an external copper bonding jumper shall be installed with each expansion fitting with one end clamped on each conduit entering fitting.

G. Flexible, Nonmetallic, Liquid-Tight Conduit shall meet requirements of UL 514B with High strength plastic body, complete with lock nut, O-ring seal, threaded ferrule, sealing ring. Threaded ferrule designed to ensure high mechanical pullout strength and watertight seal. Manufacturer, Carlon; Type LN or approved equal.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. All raceways shall be run in neat and workmanlike manner and shall be properly supported in accordance with latest edition of NEC with approved conduit clamps, hanger rods and structural fasteners except for PVC conduit installed in exterior locations. PVC conduit installed in exterior locations shall be supported at two foot intervals. Supporting conduit and boxes with wire is not approved. All raceways except those from surface-mounted switches, outlet boxes or panels shall be run concealed from view. Exposed raceways shall be supported with clamp fasteners with toggle bolt on hollow walls, and with lead expansion shields on masonry. All individual bare copper ground conductors (i.e. service, transformer, or lightning protection grounds) shall be installed in PVC conduit, not metal conduit. This does not apply to bare copper ground conductors run with feeders (as specified in this section). Conduits shall be run parallel to building walls wherever possible, exposed or concealed, and shall be grouped in workmanlike fashion. Crisscrossing of conduits shall be minimized.

B. All raceways runs, whether terminated in boxes or not, shall be capped during the course of construction and until wires are pulled in, and covers are in place. No conductors shall be pulled into raceways until construction work which might damage the raceways has been completed.

C. All raceways shall be kept clear of plumbing fixtures to facilitate future repair or replacement of said fixtures without disturbing wiring. Except where it is necessary for control purposes, all raceways shall be kept away from items producing heat.

D. All raceway runs in masonry shall be installed at the same time as the masonry so that no face cutting is required, except to accommodate boxes.

E. All raceways shall be run from outlet to outlet exactly as shown on the drawings, unless permission is granted to alter arrangement shown. If permission is granted arrangement shall be marked on field set of drawings as previously specified.

F. All underground raceways (with exception of raceways installed under floor slab) shall be installed in accordance with Section 300 5 of the NEC except that the minimum cover for any conduit shall be two feet. Included under this Section shall be the responsibility for verifying finished lines in areas where raceways will be installed underground before the grading is complete.

G. All raceways shall have an insulated copper system ground conductor throughout the entire length of circuit installed within conduit in strict accordance with NEC. Grounding conductor shall be included in total conduit fill determining conduit sizes, even though not included or shown on drawings. Grounding conductors run with feeders shall be bonded to portions of conduit that are metal by approved ground bushings. Minimum size #12AWG.

H. Insulated bushings shall be used on all rigid steel conduits terminating in panels, wire gutters, or cabinets, and shall be impact resistant plastic molded in an irregular shape at the top to provide smooth insulating surface at top and inner edge. Material in these bushings must not melt or support flame.

I. Spare conduit stubs shall have pull string pulled in, be capped and location and use marked with concrete marker set flush with finish grade or terminated in a manhole. Marker shall be 6" round X 6" deep with appropriate symbol embedded into top to indicate use. Also, tag conduits in panels where originating.

J. All conduit stubbed above floor shall be separated with plastic interlocking spacers manufactured specifically for this purpose, or shall be strapped to Kindorf channel supported by conduit driven into ground or tied to steel.

K. Raceways which do not have conductors furnished under this Division of the specifications shall be left with an approved nylon pullcord in raceway.

L. Rigid Metallic Conduit, electrical metallic tubing, flexible conduit and PVC conduit shall be manufactured within the United States.

M. All connections to motors or other vibrating equipment (except dry type transformers) or at other locations where required shall be made with not less than 12" nor more than 20” of flexible liquid-tight conduit, using special type of connectors with strain relief fittings at both terminations of conduit. Flex connectors shall have insulated throat and shall be T & B 3100 Series or approved substitution. Use angle connectors wherever necessary to relieve angle strain on flex conduit. Connections to dry type transformers shall be made with flexible conduit. Typical length of flex conduit shall be limited to 20” unless specifically approved by the engineer.

N. PVC joints shall be solvent welded. Threads will not be permitted on PVC conduit and fittings, except for rigid steel to PVC couplings. Installation of PVC conduit shall be in accordance with manufacturer's recommendations. PVC conduit shall not be used to support fixture or equipment. Field bends shall be made with approved hotbox. Heating with flame and hand held heat guns are prohibited.

O. Expansion fittings shall be installed in the following cases: In each conduit run wherever it crosses an expansion joint in the concrete structure; on one side of joint with its sliding sleeve end flush with joint, and with a length of bonding jumper in expansion equal to at least three times the normal width of joints; in each conduit run which mechanically attached to separate structures to relieve strain caused by shift on one structure in relation to the other; in straight conduit run above ground which is more than fifty feet long and interval between expansion fittings in such a runs shall not be greater than 100 feet for steel conduit and 50 feet for PVC conduit.

P. Electric metallic tubing (thin wall) where installed inside air conditioned buildings above grade shall be joined with steel fittings and steel compression connectors.

Q. Rigid metallic conduit installed underground shall be coated with waterproofing black mastic before installation, and all joints shall be recoated after installation.

R. Conduit installations on roofs shall be kept to a bare minimum. Where required, conduit shall be rigid aluminum conduit, including couplings. Conduit shall be supported above roof at least 6 inches using approved conduit supporting devices. Supports to be fastened to roof using roofing adhesive as approved by roofing contractor.

S. Underground cable identification: bury a continuous, pre-printed, bright colored metalized plastic (electronically traceable) ribbon cable marker with each underground conduit (or group of conduits), regardless of whether conduits are in ductbanks. Locate directly over conduits, 6" to 8" below finished grade. Delete this requirement under building slabs.

T. Provide for separation of instrumentation, control and power conductors. Provide a minimum of 24" inch separation for parallel runs of power conduit to instrumentation or control conduit with either conduit being PVC or Aluminum. This separation can be reduced to 8" if metallic grounded separation is provided (steel conduit).

U. Duct seal all conduit entrances. Foam seal is not acceptable.

V. All conduits with #3 wire and smaller pulled through them shall have 2 spare conductors pulled in them.

W. All conduit runs shall have (1) spare conduits installed in the run sized to match the largest conduit in the run.

-END OF SECTION-

SECTION 16120

LOW VOLTAGE WIRES AND CABLES

PART 1 -- GENERAL

1.01 REFERENCED STANDARDS

A. Institute of Electrical and Electronics Engineers, Inc./American National Standards Institute (IEEE/ANSI):

B. Standard for Flame Testing of Cables for Use in Cable Tray in Industrial and Commercial Occupancies.

C. National Electrical Manufacturers Association (NEMA): ICS 4, Industrial Control and Systems: Terminal Blocks.

D. National Electrical Manufacturers Association/Insulated Cable Engineers Association (NEMA/ICEA): WC 57/S-73-532, Standard for Control Cables: WC 70/S-95-658, Non-Shielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.

E. National Fire Protection Association NFPA-70, National Electrical Code (NEC).

F. Underwriters Laboratories, Inc. (UL44): Standard for Safety Thermoset-Insulated Wires and Cables; (UL83): Standard for Safety Thermoplastic-Insulated Wires and Cables; UL467 Standard for Safety Grounding and Bonding Equipment. UL486A Standard for Safety Wire Connectors and Soldering Lugs for use with Copper Conductors; UL 486C, Standard for Safety Splicing Wire Connections. UL510, Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape.

1.02 DEFINITIONS

A. Building Wire: Copper single conductor, cross link polyethylene insulated; type XHHW-2;

B. Cable: Multi-conductor, insulated, with outer sheath containing either building wire or instrumentation wire.

C. Instrumentation Cable (Analog signal cable): Multiple conductor, insulated, twisted Pair/Triad, with individual Pair/Triad shield and outer overall shield and outer sheath. Used for the transmission of low current (e.g., 4-20mA DC) using No. 16 AWG conductors. Common Types, TSP: Twisted shielded pair, TST: Twisted shielded triad.

D. Control Cable: Multi-conductor, insulated, with outer sheath containing building wires, No. 14, AWG. With overall shield where specified. Type SIS and MTW approved for use in the wiring of control equipment within control panels and field wiring of control equipment within switchgear, switchboards, motor control centers; otherwise type XHHW-2.

E. Power Cable: Multi-conductor, insulated, with outer sheath containing building wire, No. 12 AWG and larger. Rated XHHW-2

F. Digital signal cable: Used for the transmission of digital signals between computers, PLC's, RTU's, etc. Common Types: Ethernet UTP-unshielded twisted pair.

1.03 SUBMITTALS:

A. Submit cut sheets on all major types of wires and cables including splicing tape, and terminating/splicing lugs, conductor identification systems and connectors and cable sleeves. Submit sample of all instrumentation and control cable. Sample shall be a minimum of 24" with exterior sheath clearly marked.

B. Submit sample of all cable identification systems products.

C. Submit conduit schedule identifying conduit tag numbers, locations the conduit connects and the wire count.

PART 2 -- PRODUCTS

2.01 POWER CONDUCTORS:

A. Branch circuits and feeder conductors for all three phase electric power shall be stranded copper type XHHW-2 cross-link polyethylene (XLP) insulation and derated to 75 degrees Centigrade. No aluminum wiring shall be permitted. Wire shall be in accordance to NEC and minimum No. 12, except that branch "homeruns" over 50 ft. in length shall be minimum No. 10 for 120/208V circuits. All branch lighting circuits serving HID and Fluorescent fixtures shall be minimum #10 with each circuit provided with a separate neutral. All wire shall be manufactured in the USA.

B. Motor leads from variable frequency drives to driven motor shall be shielded VFD drive cable for all VFD motors. Provide flexible VFD shielded drive cables, 3 Class-I conductor cable plus 3 trisectional green insulated ground wires. Provide electrostatic shielding of tinned copper braided shield with aluminum-polyester laminated tape shielding system. Cross-linked polyolefin insulation system and neoprene outer jacket, type TC cable as manufactured by Rockbestos-Surprenant Cable Corp. or equal. Shielded VFD motor cables require increased conduit sizes over standard wire installations. Contractor to verify conduit sizes.

C. Taps and Splices:

1. All power wiring taps and splices in No. 8 or smaller wire shall be fastened together by means of terminal strips except within lighting fixtures and wiring devices where conformance to NEC practices will be acceptable (Twist/screw on type connectors). All taps and splices in wire larger than No. 8 shall be made with compression type connectors and taped to provide insulation equal to wire. Tape shall be heavy duty, flame retardant and weather resistant vinyl electrical tape, minimum 7 mil premium grade with an operating temperature of 0 degree F. to 220 degree F. Provide tape

meeting UL 510 and CSA standard C22.2.

2. All taps and splices in manholes or in ground pull boxes, etc. shall be approved by the engineer on a case by case basis; be made with high press long barrel double crimp compression type connectors and covered with Raychem heavy wall cable sleeves (type CTE or WCS) with type "S" sealant coating. Install sleeve kits as per manufacturer's installation instructions.

E. Color Coding:

1. All power feeders and branch circuits No. 6 and smaller shall be wired with color-coded wire with the same color used for a system throughout the building. Power feeders above No. 6 shall either be fully color-coded or shall have black insulation and be similarly color-coded with tape or paint in all junction boxes and panels. Tape or paint shall completely cover the full length of conductor insulation within the box or panel except for the wire markings.

2. Unless otherwise approved, color-code shall be as follows: Neutrals to be white for 120/208V system, natural grey for 277/480V system; ground wire green, bare or green with yellow strips. Nominal Voltage: 120/208V, Phase A -black; Phase B - red; Phase C - blue. 480/277V, Phase A brown; Phase B - orange; Phase C - yellow. All switch legs, other voltage system wiring, control and interlock wiring shall be color-coded other than those above. In exiting or expansion projects, comply with existing color coding established within the facility.

2.02 INSTRUMENTATION AND CONTROL CABLE:

A. Multiconductor and Multi pair Process instrumentation cable shall be #16 AWG stranded, twisted pair, 600 V, (XLP) cross link polyethylene insulated, aluminum tape pair shielding, cross link polyethylene or chlorinated polyethylene (CPE) overall sheathed and shielded, type TC instrument cable as manufactured by the American Insulated Wire Co., Belden Wire Co. or equal.

B. Multiconductor control cable shall be #14 AWG stranded, 600V, (XLP) cross link polyethylene insulated or polyolefin, with cross link polyethylene or chlorinated polyethylene (CPE or Hypalon) overall sheathed type TC control cable except for control cable into and out of VFD cabinets. Multiconductor control cable into and out of VFD cabinets shall be as indicated above and in addition include an aluminum polyester tape overall shield and drain wire. As a contractor alternate to shielded control cable into and out of VFD cabinets, provide twisted shielded instrument cable as specified above. Contractor to provide increased conduit size as required if instrument cable alternate is used into and out of VFD cabinets.

C. Connections:

1. All conductor connections shall be on terminal strips including all spare conductors. Provide terminal strips in all cabinets; motor control centers; etc.

2. All connections of stranded wire to screw terminals shall be by insulated spade lugs,

crimp fastened to wire. Provide stranded wire crimp ferrules for all stranded wire connections not requiring spade lugs for screw type terminal blocks. The stranded wire ferrule is to be crimped to all stranded wire using a crimping tool specifically approved for crimping the size and type of ferrule.

3. All conductors shall be marked with mylar wrap type "Brady" labels. Identification labels shall be permanent type and be machine printed. All terminal block terminations shall be labeled. The inside portion of the terminal cabinet doors shall display a protected terminal cabinet drawing with all connections shown and described as to color code, number assigned to connection function of conductor and destination.

4. Wire shall be guided within terminal cabinets by cable supports. All conductors shall be neatly led to terminations.

5. Instrumentation and control field cables on the unprotected side of SPD devices within the cabinet shall not run in parallel to the cables on the protected side of the SPD device. Separate cable supports (duct) will be provided.

6. Cabinets: All cabinets shall be labeled with an engraved plastic laminate label riveted to the door.

7. No splices shall be made within a conduit run or in manholes.

D. All plant control system field wiring shall be labeled per the instrumentation and control contractor loop drawings from the field device, through the intermediate cabinets, to the PLC cabinet. The labeling system shall be consistent throughout the loop and follow the standard tag designation: PLC#-Rack#-Slot#-Point# (example PLC1-R2-S3-P4).

E. Provide for separation of instrumentation, control and power conductors. Provide a minimum of 24" inch separation for parallel run of power conduit and instrumentation or control conduit. This separation can be reduced to 8" if metallic grounded separation is provided.

2.03 ETHERNET MEDIA CABLE

A. Multiconductor and Multi pair Data Signal cable shall be TIA 5638B Cat 5e, #22 AWG solid, twisted pair, 600V, PVC insulated, aluminum tape pair shielding, thermoplastic elastomer (TPE) overall sheathed and shielded, industrial Ethernet cable as manufactured by the Allen Bradley 1585-C8HB or equal. Option to provide premolded RJ45 patchcords Allen Bradley 1585D and 1585J is acceptable at contractor’s option.

B. Connections:
1. All conductor connections shall be to RJ45 and M12 compatible jacks.
2. All conductors shall be marked with mylar wrap type "Brady" labels. Identification labels shall be permanent type and be machine printed. All terminal block terminations shall be labeled. The inside portion of the terminal cabinet doors shall display a protected terminal cabinet drawing with all connections shown and described as to color code, number assigned to connection function of conductor and destination.

3. Wire shall be guided within terminal cabinets by cable supports. All conductors shall be neatly led to terminations.
4. Instrumentation and control field cables on the unprotected side of SPD devices within the cabinet shall not run in parallel to the cables on the protected side of the SPD device. Separate cable supports (duct) will be provided.
5. No splices shall be made within a conduit run or in manholes.

PART 3 -- EXECUTION

3.01 SPARE CONDUCTORS

A. All runs of Multi pair Process instrumentation cable and multi conductor Control cable shall have a minimum of 2 spare conductors per conduit.

-END OF SECTION-

SECTION 16130

OUTLET BOXES

1.01 GENERAL

A. Surface outlet boxes and conduit bodies shall be the heavy cast aluminum with external raised hubs and mounting lugs; Appleton, Crouse Hinds or approved substitution. Trim rings shall also be of one piece construction.

B. Outlet boxes shall be of such form and dimensions as to be adapted to the specific use and location, type of device or fixtures to be used, and number and size of conductors and arrangement, size and number of conduits connecting thereto.

C. Ceiling outlet boxes shall be 4" octagonal or 4" square X 1 1/2" deep or larger as required for number and size of conductors and arrangement, size and number of conduits terminating at them.

D. Switch, wall receptacle, telephone and other wall outlet boxes in drywall shall be 4" square X 1 1/2" deep. For furred-out block walls, provide 4" square box with required extension for block depth and required extension for drywall depth.

E. All flush outlets shall be mounted so that covers and plates will finish flush with finished surfaces without the use of shims, mats or other devices not submitted or approved for the purpose. Add-a-Depth rings or switch box extension rings (Steel City #SBEX) are not acceptable. Plates shall not support wiring devices. Gang switches with common plate where two or more are indicated in the same location. Wall-mounted devices of different systems (switches, thermostats, etc.) shall be coordinated for symmetry when located near each other on the same wall. Outlets on each side of walls shall have separate boxes. Through-wall type boxes shall not be permitted. Back-to-back mounting shall not be permitted. Trim rings shall be extended to within 1/8" of finish wall surface.

F. Outlet boxes mounted in metal stud walls, are to be supported to studs with two (2) screws inside of outlet box to a horizontal stud brace between vertical studs.

G. All outlet boxes that do not receive devices in this contract are to have blank plates installed matching wiring device plates.

H. Covers for cast boxes (flush and surface) installed in damp or wet locations shall be UL approved for weatherproof locations (UL standard 498 and 514; OSHA standard Subpart "S"; NEMA Standard WD-1) with plug inserted and shall comply with NEC-410-57b; shall be heavy cast copper free aluminum with 2 coat baked epoxy finish; self closing door with stainless steel hinge and springs; EPDM gaskets. Provide Crouse Hinds, Appleton or equal. This requirement includes outlets mounted flush in exterior lighting poles.

1.02 MOUNTING HEIGHT

A. Height of wall outlets to bottom above finished floors shall be as follows, unless specifically noted otherwise. Verify with the Architectural plans and shop drawings for installing

Switches 4' 0" Maximum to centerline

Receptacles 1' 4"

Lighting Panels (top of Panel Trim) 6' 6"

Phone Outlets 1' 4"

B. Bottoms of outlets above counter tops or base cabinets shall be minimum 2" above counter top or backsplash, whichever is highest. Outlets may be raised so that bottom rests on top of concrete block course, but all outlets above counters in same area shall be at same height. It is the responsibility of this Division to secure cabinet drawings and coordinate outlet locations in relation to all cabinets as shown on plans, prior to rough-in, regardless of height shown on Division 16 drawings.

C. Height of wall-mounted fixtures shall be as shown on the drawings or as required by Architectural plans and conditions. Fixture outlet boxes shall be equipped with fixture studs when supporting fixtures.

1.03 SPECIAL PURPOSE OUTLETS

A. Locate special purpose outlets as indicated on the drawings for the equipment served. Location and type of outlets shall be coordinated with appropriate trades involved. The securing of complete information for proper electrical roughing-in shall be included as work required under this section of specifications.

1.04 SUBMITTALS

A. Submit product data on all different types of outlet boxes, floor boxes and associated trim/plaster rings.

-END OF SECTION-

SECTION 16134

PANELBOARDS

PART 1 -- GENERAL

1.01 SCOPE

A. The CONTRACTOR shall provide panelboards and general purpose dry-type transformers, complete and operable, in accordance with the Contract Documents.

B. Single Manufacturer: Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.

1.02 REFERENCES: The latest edition of the following codes or standards shall apply.

A. NEC (NFPA 70) National Electrical Code

B. NEMA 250 Enclosure for Electrical Equipment (1,000 Volts Maximum)

C. UL 50 - Standard for Safety for Enclosures for Electrical Equipment

D. UL 67 - Panelboards

1.03 SUBMITTALS: General: Submittals shall be in accordance section 16050 Basic Materials and Methods.

A. Breaker layout drawings with dimensions and nameplate designations

B. Drawings of conduit entry/exit locations.

C. Assembly ratings including: Short circuit rating, Voltage; Continuous current

D. Cable terminal sizes

E. Descriptive bulletins

F. Product sheets

PART 2 -- PRODUCTS

2.01 GENERAL: Provide panelboards by Square-D or Cutler Hammer.

A. Panelboard shall be dead front factory assembled. Panelboards shall comply with NEMA PB-1-Panelboards, as well as the provisions of UL 50 - Safety Enclosures for Electrical Equipment and UL 67 - Panelboards. Panelboards used for service equipment shall be UL labeled for such use. Lighting panelboards shall be rated for 120/208-volt, 3-phase operation or 120/240-volt for single phase operation as indicated. Power panelboards shall be rated for 480 volts, 3-phase, 3 wire operation as indicated.

B. The manufacturer of the panelboard shall be the manufacturer of the major components within the assembly, including circuit breakers.

C. Panelboards rated 240 VAC or less shall have short circuit ratings not less than 10,000 amperes RMS symmetrical or as indicated by the Short Circuit Study, whichever is greater.

D. Panelboards rated 480 VAC shall have short circuit ratings not less than 42,000 amperes RMS symmetrical or as indicated by the Short Circuit Study, whichever is greater.

E. Panelboards shall be labeled with a UL short circuit rating. Series ratings are not acceptable.

2.02 CONSTRUCTION

A. All lighting and power distribution panels shall have copper bus bars density rated for maximum of 1,000 amps/sq-in. Enclosures for panelboards shall be galvanized and painted steel except enclosures for panelboards located in corrosive, damp or wet locations shall be stainless steel and NEMA-4X

B. Breakers shall be one, two, or three pole as indicated, with ampere trip ratings as required by the equipment. Breakers shall be quick-make and quick-break, inverse time trip characteristics, to trip free on overload or short circuit, and to indicate trip condition by the handle position. Double and triple pole breakers shall be of the common trip, single handle type.

C. The panels shall have hinged doors with combination catch and latch. The front panels shall be so arranged that when the plates are removed, the gutters, terminals and wiring will be exposed and accessible. The doors shall have inner doors within the plates to have only the breaker operating mechanism exposed when they are opened. Live conductors and terminals shall be concealed behind the plates.

D. All circuit breakers shall be interchangeable and bolt on type capable of being operated in any position as well as being removable from the front of the panelboard without disturbing adjacent units. Plug-in circuit breakers are not acceptable.

E. Panelboards shall be UL listed.

F. Size of wiring gutters and gauge of steel shall be in accordance with NEMA Standards Publication No. PBI 57 and UL Standards No. 67. Cabinets shall be minimum 20" wide for all panels.

PART 3 -- EXECUTION

3.01 GENERAL

A. Surface mount panelboards on wall, as indicated on project drawings, at an elevation convenient for operation and as required in the latest NEC.

B. Install typewritten or computer generated circuit directory in panelboards. The directory shall be coordinated with the identification of equipment as shown on the contract drawings and clearly indicating the serving load.

-END OF SECTION-

SECTION 16140

WIRING DEVICES

PART 1 -- GENERAL

1.01 SCOPE

A. The Work of this Section shall consist of furnishing all labor, materials, and equipment necessary for installation of wiring devices and plates.

1.02 REFERENCES

A. The latest edition of the following codes or standards shall apply to the design and fabrication of the products and equipment to be supplied under this contract.

1. NEC (NFPA 70) National Electrical Code
2. NETA International Electrical Testing Association - Acceptance Testing Specifications
3. NEMA 250 - Enclosure for Electrical Equipment (1,000 Volts Maximum)
4. Local Building Codes and Standards
5. UL 1449 3rd edition Standard for Surge Protection Devices
6. UL 498 Standard for Safety Attachment Plugs and Receptacles

1.03 SUBMITTALS

A. Furnish submittals in accordance with Section 16050 Special Electrical Requirements.

B. Shop Drawings: Complete catalog cuts of switches, receptacles, enclosures, covers, and appurtenances, marked to clearly identify proposed materials

C. Documentation showing that proposed materials comply with the requirements of NEC and U.L.

1.04 TESTING

A. Provide checkout, field, and functional testing of wiring devices in accordance with Section 16051.

B. Test each receptacle for polarity and ground integrity with a standard receptacle tester.

C. Test GFCI receptacle for correct tripping operation with tester.

PART 2 -- PRODUCTS

2.01 SNAP SWITCHES

A. Unless otherwise specified, each snap switch (flush tumbler-toggle) shall be of the Specification grade, heavy-duty type for mounting in a single-gang spacing, fully rated 20 amperes, minimum, at 120-277 VAC, conforming to minimum requirements of the latest revision of the UL.

B. Switches shall operate in any position and shall be fully enclosed cup type with entire body molded phenolic or melamine. Fiber, paper of similar insulating material shall not be used for body or cover. Ivory color handles unless otherwise indicated on the drawings. Silver or silver alloy contacts. Brass contact arm.

C. Switches for hazardous locations shall be factory sealed, rated at 20 amperes, 120-277 VAC, capable of controlling 100 percent tungsten filament, fluorescent and HID lamp loads.

2.02 RECEPTACLES

A. Industrial or Hospital Grade: receptacles shall be in accordance with NEMA Publications and UL Listings. Receptacles shall be rated for 125VAC, 20 amperes, shall be polarized 3 wire type for use with 3 wire cord with grounded lead and 1 designated stud shall be permanently grounded to the conduit system (NEMA 5-20R). Receptacles shall also be fire-resistant, with nylon top (face) and bodies and bases with metal plaster ears (integral with the supporting member).

B. Provide single or duplex receptacles as shown or noted on drawings, and ivory color unless otherwise noted, with triple wipe or equivalent brass alloy power contacts for each prong. Approved manufacturers are Hubbell, Cooper, Pass & Seymour, or Leviton.

C. Ali receptacles shall be grounding type with a green-colored hexagonal equipment ground screw of adequate size to accommodate an insulated grounding jumper in accordance with NEC, Article 250. Grounding terminals of all receptacles shall be internally connected to the receptacle mounting yoke.

D. GFCI: Ground-fault circuit interrupting receptacles (GFCI's) shall be installed at the locations indicated and as required by the NEC. GFCI's shall be duplex, Industrial or Hospital grade, tripping at 5 mA. Ratings shall be 125 V, 20 amperes, NEMA WD-1, Configuration 5-20R, capable of interrupting 5,000 amperes without damage.

E. Provide GFCI receptacles where shown and as required. Feed-through type GFCI's serving standard receptacles will not be permitted.

F. Pedestal type boxes for receptacles shall be cast iron 3/4 inch N.P.T. tapped flanged inlet; double gang, meeting UL Standard 514.

G. Special purpose receptacles shall have ratings and number of poles as indicated or required for anticipated purpose. Matching plug with cord-grip features shall be provided with each special-purpose receptacle.

H. Receptacles for hazardous locations shall be single gang receptacles with spring door. Receptacles shall have a factory sealed chamber. The receptacles shall have a delayed action feature requiring the plug to be inserted in the receptacle and rotated before the electrical connection is made. The receptacle shall not work with non-hazardous rated plugs. One plug shall be furnished with each receptacle. The receptacles shall be rated for 20 amps at 125 VAC.

I. SPD Receptacles: Transient voltage surge suppressing receptacles provided with a filtering capacitor for 7 to 1 average noise reduction and Two way protection for line equipment. Response time less than 1 nanosecond for un-mounted Metal Oxide Varistor (MOV); Overcurrent protection; Thermal protection; Varistor with voltage capabilities of 150V RMS

J. Outdoor mounted Receptacles shall be corrosion resistant and shall in addition to meeting the requirements of general-purpose receptacle have Nickel coated metal parts. Manufacturer; Hubbell Bryant; 20A rated HBL53CM62 Series or equal.

K. Outdoor mounted Receptacles shall be furnished with aluminum weatherproof while in use covers.

2.03 SWITCH, MOTOR RATED: Two-pole or three-pole, manual motor starting/disconnect switch without overload protection. UL 508 listed. Totally enclosed snap-action switch. Quick-make, slow-break design with silver alloy contacts. Minimum General Purpose Rating: 30 amperes, 600V ac. Manufacturer: Cooper Arrow Hart; Hubbell Bryant: HBL78 Series; Leviton.

2.04 PLUG CAPS & CORDS: Provide and install a matching plug cap and properly sized cord for equipment items noted on the drawings.

2.05 DEVICE PLATES

A. Provide device plates for each switch, receptacle, signal and telephone outlet, and special purpose outlet. Do not use sectional gang plates for multi-gang boxes. All Plates shall be of stainless steel.

PART 3 -- EXECUTION

3.01 GENERAL: Perform work in accordance with the National Electrical Code.

3.02 CONNECTION: Rigidly attach wiring devices in accordance with National Electrical Code. Coordinate installation avoiding interference with other equipment.

3.03 GROUNDING: Ground all devices, including switches and receptacles, in accordance with NEC, ART 250.

A. Ground switches and associated metal plates through switch mounting yoke, outlet box, and raceway system.

B. Ground flush receptacles and their metal plates through grounding jumper connections to outlet box and grounding system.

-END OF SECTION-

SECTION 16150

ELECTRIC MOTORS

PART 1 -- GENERAL

1.01 DESCRIPTION

A. This section describes materials, installation and testing of induction motors and applies to motors which are provided as part of equipment specified in other sections. Contractor shall furnish motors in conformance to this section and with the individual specification sections of the driven equipment for a complete and operable system. It shall be the contractor's responsibility to bring to the attention of the engineer any conflict between this section and the driven equipment section for engineer's resolution prior to purchase; in general most stringent best quality governs.

B. Motors which are an integral part of standard manufactured driven equipment (submersible pumps, motor valve operators) may be exempt from this specification where necessary and required by the manufacturer of the equipment.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 16165 Variable Frequency Drives

B. Section 16035 Acceptance Testing & Performance Verification

1.03 SUBMITTALS

A. Submit shop drawings in accordance with the General Conditions.

B. Show complete nameplate data, horsepower, current, voltage, phase, and frequency ratings, NEMA design, Frame Size, starting code letter or locked rotor KVA, efficiency and power factor, winding insulation class and treatment, rated ambient temperature, service factor, mounting arrangements, size and location of conduit entry, location and size of grounding lug, and coatings.

C. Submit guaranteed full load efficiency.

1.04 FACTORY TESTS

A. Tests shall comply with NEMA Standard MG1-12.51 and MG 1-23.46.

B. For high efficiency motors, provide certified test results of percent efficiency and power factor data at full, 75% and 50% load.

C. Test thermally protected motors in accordance with NEMA Standard MG 1 winding temperature and trip current tests.

1.05 CONTROLLER COORDINATION

A. Where motor controllers are furnished, provide reviewed shop drawings to the controller manufacturer for coordination and sizing of the controller.

1.06 QUALITY ASSURANCE

A. NEMA Compliance: Unless otherwise indicated, comply with NEMA standard MG 1.

B. U.L. Listing: Motors for applications in hazardous locations shall bear the U.L. label listing its use in accordance with NEC.

C. ANSI/IEEE 112; Test Procedures for polyphase induction motors.

PART 2 -- PRODUCTS

2.01 GENERAL MOTOR DESIGN REQUIREMENTS

A. All motors furnished shall be designed, manufactured, and tested in accordance with the latest applicable standards of NEMA, ANSI, IEEE, and ASTM. As a minimum requirement, all motors shall conform to the latest applicable sections of NEMA Standard No. MG-1. Motors must meet or exceed CEE Premium Efficiency™ full load efficiencies. The Consortium for Energy Efficiency (CEE), a national, non-profit public benefits corporation, promotes the manufacture and purchase of energy-efficient products and services.

B. Per CEE Premium Efficiency™ Criteria, minimum efficiencies for TEFC motors shall be equal to or greater than those shown below:

HP	1200 RPM	1800 PM	3600 RPM
1	82.5	85.5	78.5
1.5	87.5	86.5	85.5
2	88.5	86.5	86.5
3	89.5	89.5	88.5
5	89.5	89.5	89.5
7.5	91.7	91.7	91.0
10	91.7	91.7	91.7
15	92.4	92.4	91.7

20	92.4	93.0	92.4
25	93.0	93.6	93.0
30	93.6	93.6	93.0
40	94.1	94.1	93.6
50	94.1	94.5	94.1
60	94.5	95.0	94.1
75	95.0	95.4	94.5
100	95.4	95.4	95.0
125	95.4	95.4	95.4
150	95.8	95.8	95.4
200	95.8	96.2	95.8

C. Unless otherwise specified or specifically required by the manufacturer of the equipment to be driven, alternating current motors shall be single speed, non-reversing, squirrel cage induction motors, NEMA design B. Motors 15 horsepower and larger shall be NEMA starting code F or G. Motors smaller than 15 horsepower may be manufacturers' standard starting characteristics. Stator windings shall be copper.

D. The connected load (maximum horsepower required) of each motor shall not exceed its nameplate horsepower rating (exclusive of service factor) under any operating condition.

E. Connection box shall be cast metal with gaskets between the box and housing and between the box and cover. Provide a grounding terminal in the connection box.

F. Open dripproof and weather-protected motors shall have a service factor of 1.15. Inverter Duty (VFD) rated motors shall have a service factor of 1.15 for sine wave power and 1.0 for inverter power. Totally enclosed fan cooled motors shall have a service factor of 1.15.

G. Unless otherwise noted, motors shall be rated for continuous duty at an ambient temperature of 40 degree C and at an altitude of 3,300 feet. High ambient Motors shall be rated for continuous duty at an ambient temperature of 65oC. Motors shall have 120-volt heating elements.

H. Non-submersible Motors shall have 120-volt heating elements.

I. Open dripproof and weather-protected motors 7.5 HP and larger shall have stainless steel screens over openings.

J. Motors installed in hazardous areas shall be Totally enclosed, explosion proof, suitable for use in Class 1, Division I, Group D hazardous locations, with UL label.

K. Provide motors with a guaranteed maximum noise level of 90dBA, measured at three feet from the motor surface per IEEE 85, when running at no-load connected to sine wave power.

L. Unless otherwise noted, motors shall be premium efficiency type. The efficiency shall be determined by IEEE 112 method B using sine wave power for motors up to 300 horsepower and method F for motors above 300 horsepower. Efficiency shall be listed on the nameplate in accordance with NEMA MG 1 12.53.

M. As a minimum all motors shall have manufacturer's standard tropical protection. Motors in wet locations shall be moisture sealed. Motors with form-wound coils shall have vacuum-pressure impregnated windings.

N. Motors designated to be Totally Enclosed Fan Cooled (TEFC) shall be rated for IEEE-841-2001 standards or Coro-duty where listed in pump sections of specifications. TEFC motors shall be premium efficient, all cast iron including conduit box and fan cover guard, with stainless steel nameplate and plated hardware, with internal bearing caps and an inpro/seal on the drive end. Motor finishes shall be rated for 250hour salt spray. TEFC motors shall have a 5 year warranty.

O. In addition to nameplate information required by NEMA Standard MG 1-10.37 through 39, show on the nameplate the bearing numbers for both bearings, efficiency, power factor at full load and the maximum recommended kVAR of power capacitors to result in a 90 percent power factor. Provide all motors with stainless steel nameplates.

P. Equip all motors with thermal protection in accordance with NEMA Standard MG 1. Control leads shall be color-coded, brought out to the motor conduit box or a separate terminal box for connection.

1. Provide three series connected, thermal switches, one in each winding. Provide normally closed and normally open switches as shown on the electrical elementary drawings. Where not shown provide normally closed switches.

2.02 BEARINGS

A. Bearings for standard duty motors shall be rated for a minimum of 24,000 hours (B-10 rating); Heavy duty specified motors bearings shall be rated for a minimum of 40,000 hours (B-10 rating). Where unspecified provide bearings with B-10 ratings as follows: Less than 50hp provide 24,000hr B-10 rating; 50hp to 200hp provide B-10 rating of 40,000hr; greater than 200hp provide B-10 rating of 100,000hr.

B. Bearings shall be ball or roller anti-friction type. Fractional horsepower through 2 horsepower motors shall be furnished with life time lubricated bearings. Horizontal motors larger than 2 horsepower shall be furnished with relubricatable ball bearings.

C. Vertical Motors

1. Vertical motors shall be designed for vertical operation and shall have thrust bearings with a rated B-10 life of 40,000 hours as defined by Anti-Friction Bearing Manufacturers Association (AFBMA).

2. Thrust bearings for motors 75 horsepower and larger shall be oil lubricated. Guide bearings may be anti-friction, grease lubricated or oil lubricated.

3. Equip grease lubricated bearings with fittings in each bearing housing. Fittings shall be accessible without removal of any covers or guards. Provide drains to prevent over-lubrication.

D. Equip motors with a non-reversing ratchet as required or as indicated.

E. Bearing Protection

1. Provide bearing protection from shaft currents for all motors 20hp or greater and driven by variable frequency drives. The device shall divert shaft currents to ground or insulate the shaft so currents will not flow through bearings. The device shall be maintenance free. Provide current diverter seal equal to Inpro-Seal type CDR.

2.03 INSULATION AND TEMPERATURE RISE

A. Unless otherwise noted, provide Class F insulation limited to Class B temperature rise at unity service factor.

B. All motors indicated to be heavy duty motors in the individual equipment specifications of the contract documents shall be provided with minimum Class "H" insulation system limited to Class "B" temperature rise at unity service factor.

2.04 VOLTAGE

A. Generally provide alternating current motors 1/2 horsepower and smaller at 115 volts single phase 60 Hz, and motors 3/4 horsepower and larger at 460 volts three phase 60 Hz. Contractor shall coordinate exact requirements.

2.05 COATING

A. Do not coat cast aluminum frame motors.

B. Motors housed within equipment enclosures, such as exhaust fans, air handling units, and air conditioners, may have factory's standard prime and finish coats.

C. Coat cast-iron frame motors. Apply prime coat at the factory which shall be compatible with field applied finish coats.

D. Field apply finish coat(s) specified in the applicable equipment section.

2.06 INVERTER DUTY RATED MOTORS

A. Inverter duty rated motors (variable frequency drive (VFD) controlled motors) shall have a nameplate that states "SUITABLE FOR VFD APPLICATION". VFD motors shall not have a critical vibration frequency within the operating range of the VFD. Provide VFD rated motors with special balance option. Provide balance to .0005in for high thrust and 3600rpm motors; .0010in for all other motors.

B. Except where noted, the motor features defined by this specification shall be in addition to any mechanical and electrical feature defined in the fixed speed motor section.

C. Motor insulation shall be an "Inverter Grade" system designed to meet the voltage spike limits defined by NEMA MG1, Part 31, 1993. The insulation system must include the use of High Dielectric magnet wire which exceeds the dielectric withstand levels provided by double film or heavy film magnet wire. Complete insulation of the slot, cell and phase groups is required. The system shall be rated for class F rise or better. The winding insulation system shall be equal to Phelps Dodge Thermaleze Quantum Shield. The system shall exhibit an insulation pulse endurance life expectancy of 150% at 60HZ when compared to typical heavy film insulation systems. The system shall exhibit an insulation pulse endurance life expectancy from fast rise time IGBT inverters of 100% at a 2.0KHZ carrier frequency.

D. Motors shall be capable of operating at 1.0 service factor on Inverter Power. Nameplate Sinewave service factor shall be 1.15 or greater.

E. Motor temperature rise shall not exceed class F insulation limits, with 115C allowable winding hot spot temperature, when operated on Inverter Power across its nameplate speed and torque envelope. Sinewave temperature rise shall be class F or better.

F. The 2 pole 4 pole 6 pole 8 pole motors shall be capable of operating a Variable Torque centrifugal pump load from base speed down to 10% of base speed. Motor shall be nameplated for 6-60 Hertz operation. Hazardous location motors may be nameplated 10-60 Hertz.

G. Stator core designs shall be of high rigidity with reinforced end turn construction to minimize mechanical fatigue of the winding, and to reduce resonant noise. Single dip and bake cycles are not acceptable.

H. Winding thermal protection, utilizing normally closed contacts (or normally open where shown on the electrical drawings) shall be sized to match the maximum safe operating temperature of the insulation system. Hazardous location motors shall have winding thermal protection sized as required to meet U.L. or as auxiliary devices where not required by U.L.

I. Maximized copper content shall be utilized to achieve high motor efficiency and thermal transfer. Table 1 lists the minimum NEMA nominal efficiency levels that must be nameplated on the motor. Low loss electrical steel shall be utilized in the stator and rotor core assemblies.

J. Nameplate data for adjustable speed operation shall be stamped on a stainless steel data plate and permanently attached to the motor frame. The minimum amount of adjustable speed data shall include:

1. Application Type - Variable Torque and/or Constant HP.

2. Maximum approved continuous HP.

3. Approved speed range.

4. Typical motor volts per hertz.

5. S.F. on inverter power.

PART 3 -- EXECUTION

3.01 STORAGE

A. Protect motors from exposure of elements for which they are not designed. Install and energize temporary electrical service to motors with electrical heaters.

B. Unless protected by manufacturer's packing, upon delivery, carefully wrap each motor in three layers of 8-mil minimum polyethylene. Secure the wrap with adhesive tape to minimize the entrance of moisture. For base mounted motors, wrap the entire assembly.

3.02 FIELD OPERATING TESTS

A. Run each motor with its control as nearly as possible under operating conditions to demonstrate correct rotation direction, alignment, wiring size, proper overload relay sizing, speed and satisfactory operation. Test interlocks and control features to verify correct wiring and operation.

B. Record current in each phase of each motor 1 horsepower and larger and include in the maintenance manual. Repair or replace motor or driven equipment if current exceeds motor nameplate value.

END OF SECTION-

SECTION 16160

MOTOR CONTROL CENTERS

PART 1 -- GENERAL

1.01 SCOPE

A. The Contractor shall furnish and install the motor control centers as specified herein and as shown on the Contract Drawings.

1.02 RELATED SECTIONS

A. Section 16180, Circuit Breakers and Fusible Switches Low Voltage.

B. Sections 16165, Variable Frequency Drives.

C. Section 16709, Surge Protective Devices.

1.03 REFERENCES

A. Equipment shall be manufactured in a certified ISO 9001 facility and shall be designed and tested to the latest edition of the following standards:

1. UL 845, UL Listed

2. National Electrical Manufacturers Association (NEMA) ICS 18-2001

3. NEMA ICS 2.3 – Instruction for Handling, Operation and Maintenance of Motor Control Centers

4. Canadian Standards Association – (CSA) C22.2 No. 245-05

5. Electrical Equipment Manufacturers Association of Canada (EEMAC)

6. National Electrical Code - NFPA 70

1.04 SUBMITTALS – FOR REVIEW/APPROVAL

A. The following information shall be submitted to the Engineer:

1. Master drawing index.

2. Front view elevation.

3. Floor plan.

4. Top view.

5. Unit wiring diagrams.

6. Nameplate schedule.

7. Starter and component schedule.

8. Conduit entry/exit locations.

9. Assembly ratings including:

    a. Short-circuit rating.

    b. Voltage.

    c. Continuous current.

10. Major component ratings including:

    a. Voltage.

    b. Continuous current.

    c. Interrupting ratings.

11. Cable terminal sizes.

12. Product data sheets.

B. Where applicable the following information shall be submitted to the Engineer:

1. Busway connection.

2. Connection details between close-coupled assemblies.

3. Key interlock scheme drawing and sequence of operations.

1.05 SUBMITTALS

A. The following information shall be submitted for record purposes:

1. Final as-built drawings and information for items listed in Paragraph 1.04, and shall incorporate all changes made during the manufacturing process.

2. Unit wiring diagrams.

3. Certified production test reports.

4. Installation information.

1.06 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

1.07 REGULATORY REQUIREMENTS

A. The motor control centers shall bear a UL label.

1.08 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

B. Use space heaters in outdoor motor control units to prevent condensation before motor control unit is energized.

1.09 OPERATION AND MAINTENANCE MANUALS

A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

A. Square D Model 6 or Cutler Hammer.

2.02 RATINGS

A. The Motor Control Center(s) shall be 600-volt class suitable for operation on a three-phase, 60 Hz system. The system operating voltage and number of wires shall be as indicated on the Drawings.

B. The Motor Control Center bus shall be braced for a minimum of 65K amperes, the main breakers shall have a minimum fully rated interrupting capacity of 65kAIC.

2.03 CONSTRUCTION

A. Structures shall be totally enclosed, dead-front, free-standing assemblies. Structures shall be capable of being bolted together to form a single assembly.

B. The overall height of the MCC shall not exceed 90 in (not including base channel, lifting angle, baffle, or plenum). Base channels, of 1.5 in in height, and lifting angles, of 3 in in height, shall be removable. The total width of one section shall be 20 in; (widths of 25 in, 30 in, and 35 in can be used for larger devices).

C. Structures shall be NEMA/EEMAC type 1A (gasketed general purpose).

D. Each 20 in. wide standard section shall have all the necessary hardware and bussing for modular plug-on units to be added and moved around. All unused space shall be covered by hinged blank doors or appropriate cover plate and equipped to accept future units. Vertical bus openings shall be covered by automatic bus shutters.

E. Each section shall include a top plate (single piece or two-piece). MCC shall have single piece top plate with exhaust flaps as specified in 2.04 G below. Top and bottom plates shall be removable for ease in cutting conduit entry openings.

F. Each unit compartment shall be provided with an individual front door. Starters and feeder-unit doors shall be interlocked mechanically with the unit disconnect device to prevent unintentional opening of the door while energized and unintentional application of power when door is open. Means shall be provided for releasing the interlock for intentional access to the interior at any time and intentional application of power, if desired, while door is open. Padlocking arrangements shall permit locking the disconnect device OFF with at least three padlocks with door closed or open. Unit disconnect operating handle shall be mounted on the disconnect, not on the unit door and shall indicate ON and OFF with door open or closed. Means shall be provided for padlocking the unit in the partially withdrawn position. Overload relays shall be reset from outside the enclosure by means of an insulated bar or button.

2.04 WIREWAYS

A. Structures shall contain a minimum 12 in high horizontal wireway at the top of each section and a minimum 6 in high horizontal wireway at the bottom of each section. These wireways shall run the full length of MCC to allow room for power and control cable to connect between units in different sections.

B. A full-depth vertical wireway shall be provided in each MCC section that accepts modular plug-on units. The vertical wireway shall connect with both the top and bottom horizontal wireway. The vertical wireway shall be 4 in. wide minimum with a separate hinged door. There should be a minimum of 80 in.2 of cabling space available for 20-inch-deep sections. Access to the wireways shall not require opening control unit doors. Structures that house a single, full section control unit are not required to have vertical wireways. Those control units must open directly into the MCC horizontal wireways.

2.05 BARRIERS

A. All power bussing and splice connections shall be isolated from the unit compartments and the wireways. The horizontal bus shall be mounted onto a glass filled polyester support assembly that braces the bus against the forces generated during a short circuit. The horizontal bus shall be isolated from the top horizontal wireway by a two-piece rigid non-conductive barrier. The barrier design shall allow qualified personnel to slide the barriers both left and right, to allow access to the bus and connections for maintenance without having to remove the barrier. Barrier sliding shall occur via an upper and lower track system.

B. The vertical bus shall be housed in a molded glass-filled polyester support that provides bus insulation and braces the bus against the forces generated during a short circuit. These supports shall have openings every 3 in for unit stab-on connections. Each opening shall be provided with a manual shutter to close off the stab opening. These shutters shall be attached to the structure so that when they are removed (to allow a stab connection) they are retained in the structure and are readily accessible for use should a plug-in unit be removed from the MCC.

C. Barriers shall be provided in the vertical structure and unit designs to prevent the contact of any energized bus or terminal by a fishtape inserted through the conduit or wireway areas.

D. Automatic shutters shall be provided for each plug-on unit which will automatically close to cover the vertical bus opening with a non-conductive shutter when the unit is removed from the MCC and automatically open the vertical bus opening as the unit is inserted in the same location in the MCC.

2.06 BUS

A. Each structure shall contain a main horizontal tin-plated copper bus, with minimum ampacity as indicated on contract drawings. Vertical bus feeding unit compartments shall be tin-plated copper and shall be securely bolted to the horizontal main bus. All joints shall be front-accessible for ease of maintenance. The vertical bus shall have a minimum rating of 300amps. Both vertical and horizontal bus shall be fully rated and shall not be tapered. All buss shall be density rated at a maximum of 1000A/square-inch.

B. The vertical bus shall be completely insulated by means of a labyrinth design barrier. It shall effectively isolate the vertical buses to prevent any fault-generated gases to pass from one phase to another. Buses shall be braced for 100K amperes RMS symmetrical, minimum.

C. A tin-plated copper ground bus shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the motor control center. The ground bus shall be located in the bottom horizontal wireway.

D. Each structure shall contain tin-plated vertical ground bus rated 300 amperes. The vertical ground bus shall be directly connected to the horizontal ground bus via a tin-plated copper connector. Units shall connect to the vertical bus via a tin-plated copper stab.

2.07 WIRING/TERMINATIONS

A. Wiring shall be NEMA Class-II Type- B

B. Motor Control Units shall include all protective devices and equipment as listed on drawings or as included in these specifications, with necessary interconnections, instrumentation, and control wiring.

C. Control wiring conductor shall have heat shrink identification labels on each end of termination. Terminations shall be made to screw terminal strips. All points of terminal strips are to be labeled to match conductor labeling.

D. Each control wiring conductor shall have heat shrink identification labels on each end of termination. Terminations shall be made to screw terminal strips. All points of terminal strips are to be labeled to match conductor labeling. Control wiring shall be SIS or XHHW insulated; PVC insulated wire is not acceptable.

2.08 MOTOR CONTROLLERS

A. Combination Starters

1. Magnetic starters shall be furnished in all combination starter units. All starters shall utilize NEMA/EEMAC rated contactors. Starters shall be provided with a three-pole, external manual reset, overload relay for ambient compensated bimetallic thermal overload units.

2. When provided, control circuit transformers shall include two primary protection fuses and one secondary fuse (in the non-ground secondary conductor). The transformer shall be sized to accommodate the contactor(s) and all connected control circuit loads. The transformer rating shall be fully visible from the front when the unit door is opened.

3. When a unit control circuit transformer is not provided, the disconnect shall include an electrical interlock for disconnection of externally powered control circuits.

4. Auxiliary control circuit interlocks shall be provided where indicated. Auxiliary interlocks shall be field convertible to normally open or normally closed operation. Minimum of two normally open auxiliary contacts in addition to the normally open auxiliary seal-in interlock, and shall be suitable for the addition of at least two additional external electrical interlocks of any arrangement normally open or normally closed.

5. NEMA/EEMAC Size 1-4 starters shall be mounted directly adjacent to the wireway so that power wiring (motor leads) shall connect directly to the starter terminals without the use of interposing terminals. Larger starters shall be arranged so that power wiring may exit through the bottom of the starter cubical without entering the vertical wireway.

6. Each starter shall be equipped with a fused, 120V ac nominal, control power transformer, two (2) indicating lights, Hand-Off-Auto (HOA) selector switch, and two (2) normally open contacts, unless otherwise scheduled on the drawings.

7. Each combination unit shall be rated 100,000 AIC symmetrical at 480 volt minimum. The HMCP shall provide adjustable magnetic protection and be adjustable to 1,700 percent motor nameplate full load current to comply with NEC requirements. All HMCP combination starter units shall have a “tripped” position on the unit disconnect and a push-to-test button on the HMCP. Type HMCP motor circuit protectors through size 4 shall include transient override feature for motor inrush current. HMCP shall be used to provide IEC 947-4 Type 2 coordination to 100,000 amperes.

8. Starters shall be rated in accordance with NEMA sizes and horsepower ratings. All starters shall be gravity dropout. All starters Size 5 and smaller shall have double break silver alloy contacts; starters 6 and larger shall employ single break contacts. All contacts must be capable of being inspected, and must be removable, without removing line or load wiring. Coils on starters, Size 5 and smaller, shall be molded construction. ON size 6 and larger, coils may be form wound, taped, varnished and baked.

B. Solid State Reduced Voltage Starters

1. Provided where shown on the Contract Drawings.

2. Starter shall be UL and CSA listed in the motor control center.

3. Microprocessor based SSRVS shall employ SCR-based power section, logic board and paralleling bypass contactor.

4. The paralleling bypass contactor shall be energized when the motor reaches full speed.

5. Where shown on the drawings provide solid state motor controller (starter). Size SSSS to run continuously at 115% of full load current at 50oC outside ambient air temperature. The unit shall function over a +\- 20% range of line and control voltage from nominal line voltages, and up to 50oC ambient outside air temperature, 5 to 95% relative humidity, non-condensing, and within a frequency range of 55 to 65 Hz.

6. The solid state starter shall include circuitry to set and adjust an initial motor torque, ramp an adjustable time of 1/2 to 30 seconds, and run the motor. Upon stop, starter must ramp down and then soft stop. Starters without this intelligence cannot be accepted.

7. The controller provides the following modes of operation: soft start with selectable kickstart, current limit starting, or across-the-line starting.

8. Soft Start method: The motor is raised to an initial torque value. The initial torque is adjustable between 5 and 90% of locked rotor torque. The motor voltage is gradually increased during the acceleration ramp time, which can be adjusted from 2 to 30 seconds. Provide initial ramp time setting of 6 seconds. At startup, verify 50% speed is obtained in no more than 3 seconds. Should 50% speed not be obtained in 3 seconds, reconfigure ramp with kick start feature, gradually increasing kick start to obtain 50% speed in 3 seconds.

9. Provide Soft Start with Selectable Kickstart. Kickstart is intended to provide a current pulse of 500% of full load current and is adjustable from 0.4 to 2 seconds. This will allow the motor to develop additional torque at start for loads which may need a boost to get started.

10. Provide solid state starters with Current Limit Starting mode. Current limit starting is used to limit the maximum starting current. Current limit shall be adjustable for 50 to 450% of full load amperes with initial setting of 300%. The controller shall be capable of programmable limit on starts per hour.

11. Undervoltage and overvoltage protection: The controller undervoltage and overvoltage protection will halt motor operation if a drop (or rise) in incoming line voltage is detected. The undervoltage/overvoltage trip level is adjustable as a percentage of the programmed line voltage from 0-99%. Provide undervoltage/overvoltage protection with a programmable trip delay time of 0-99 seconds.

12. Voltage Unbalance Protection: The voltage unbalance protection shall be capable of monitoring all three phases of the supply voltage in association with the rotational relationship of the three phases. The controller will halt motor operation when the calculated voltage unbalance reaches a user programmed trip level. The voltage unbalance trip level shall be programmable from 0 to 25% with initial setting of 3.5%.

13. Electronic motor overload protection: Provide unit with electronic motor overload protection programmable for the full load current of the motor.

14. Provide door mounted HMI with LCD display and full numeric keypad. HMI shall consist of two line 16 character backlit LCD display. Provide the following power monitoring parameters: Three phase current, Three phase voltage, Power in KW, Power Factor, Motor thermal Capacity, Elapsed run time.

C. Terminal Blocks

1. When Type B wiring is specified, all starter units shall be provided with unit control terminal blocks.

2. Terminal blocks shall be the pull-apart type with a minimum rating of 250 volt and 10 amps. All current carrying parts shall be tin plated. Terminals shall be accessible from inside the unit when the unit door is opened. Terminal blocks shall be DIN rail mounted with the stationary portion of the block secured to the unit bottom plate. The stationary portion shall be used for factory connections, and shall remain attached to the unit when removed. The terminals used for field connections shall face forward so they can be wired without removing the unit or any of its components.

3. When Type C wiring is specified, all starter units shall be provided with unit control terminal blocks as described for Type B wiring along with power terminal blocks for size 1-3 units. An additional set of terminal blocks shall be provided in a terminal compartment located in each section. These terminal blocks shall be pre-wired to the unit terminals so that all field control connections can be made at the terminal compartments.

D. Miscellaneous Devices

1. Each combination starter unit shall be proved with a hinged/removable control station plate, which can accommodate up to five 22 mm pilot devices or three 30 mm pilot devices.

2. Indicator pilot lamps shall be push to test type, LED full voltage type and mounted in Nema 4X (800H) modules. Lamp modules shall be equipped to operate at 24 or 120 volt input. Lamps shall be easily replaceable from the front of the control compartment door without removing lamp module from its mounted position. Units shall be heavy-duty, oiltight, industrial type with screwed on prismatic glass lenses in colors as indicated, and shall have factory engrave legend plates. LED's shall be high illumination type (5ma at 130V ac).

3. Provide phase loss, phase imbalance protection. Provide phase monitor relay. Relay shall be 2-10% phase imbalance adjustable and time delayed. The unit shall sense phase imbalance, phase loss, undervoltage and phase sequence.

4. Provide Elapsed Time Meters in control panel fronts. Meters shall be synchronous motor driven and 0 to 9999.9 hour range; rated for 120 volt 60HZ operation; Eagle Signal type 705, Agastat or equal.

2.09 OVERCURRENT DEVICES

A. Circuit Breakers:

1. Individual feeder breakers shall have a minimum full rated interrupting capacity of 100kAIC at rated voltage or as scheduled on the Drawings.

2.10 INCOMING FEEDER TERMINATIONS AND DEVICE

A. Incoming cable shall terminate within the control center on a main breaker termination point. Main lug terminations shall have adequate dedicated space for the type and size of cable used and the lugs shall be two hole long barrel double compression-type with anti-turn feature. Main breakers shall be provided as indicated on the drawings and shall be molded case unless otherwise noted as power circuit breakers, stored energy device.

2.11 OWNER METERING

A. Provide a separate, owner metering compartment with front hinged door.

B. Provide as a minimum of three (3) current transformers for each meter. Current transformers shall be wired to shorting-type terminal blocks.

C. Provide potential transformers including primary and secondary fuses with disconnecting means for metering as shown on the Drawings.

D. Microprocessor-Based Metering System. Provide Square-D PM820 power monitor with Ethernet TCP/IP communication module. No equal.

2.12 ENCLOSURES

A. The type of enclosure shall be in accordance with NEMA standards for NEMA Type 1A or as shown on the drawings. All enclosing sheet steel, wireways and unit doors shall be gasketed.

2.13 NAMEPLATES

A. Shall be engraved phenolic nameplates for each MCC and unit compartment. Provide nameplates as specified in 16050 to match other facility equipment.

2.14 FINISH

A. The control center shall be given a phosphatizing pretreatment. The paint coating shall be a polyester urethane, thermosetting powder paint. Manufacturer's standard color shall be used. All structural steel and panels will be painted.

B. The control center finish shall pass 600 hours of corrosion-resistance testing per ASTM B 117.

2.15 SPARE PARTS

A. The manufacturer shall supply for each type of motor control, spare parts from a list of recommended spare parts. As a minimum, provide spare parts as follows: Six of each type fuse; time delay relay, control relay, overload heaters, coil surge suppressor, pilot light assemblies, boxes of lamps, switch assemblies; One of each type overload relay block, across the line starter, contactor; surge suppression module, sensing relay, transducer, and terminal block.

PART 3 -- EXECUTION

3.01 FACTORY TESTING

A. Representative motor control centers shall have been tested in a high-power laboratory to prove adequate mechanical and electrical capabilities.

B. All factory tests required by the latest ANSI, NEMA and UL standards shall be performed.

C. A certified test report of all standard production tests shall be available to the Engineer upon request.

3.02 FIELD QUALITY CONTROL

A. Provide the services of a qualified factory-trained manufacturer's representative to assist the contractor in installation and startup of the equipment specified under this section as determined by the engineer. The manufacturer's representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.

B. The following minimum work shall be performed by the Contractor under the technical direction of the manufacturer's service representative:

1. Rig the MCC assembly into final location and install on level surface.

2. Check all removable cells and starter units for easy removal and insertion.

3. Perform insulation tests on each phase and verify low-resistance ground connection on ground bus.

4. Connect all power wiring and control wiring and verify basic operation of each starter from control power source.

5. Torque all bolted connections made in the field and verify all factory bolted connections.

6. Calibrate any solid-state metering or control relays for their intended purpose and make written notations of adjustments on Record Drawings. Perform startup of any solid-state starters and adjustable frequency drives.

7. Touch-up scratched or marred surfaces to match original finish.

C. The Contractor shall provide three (3) copies of the manufacturer's field startup report.

3.03 INSTALLATION

A. Examine area to receive motor-control units to assure adequate clearance for motor control unit installation.

B. Mount motor control centers on 4" concrete base extending 3" outside all rides. Check that concrete pads are level and free of irregularities for motor control centers.

C. Start work only after unsatisfactory conditions are corrected.

3.04 MANUFACTURER'S CERTIFICATION

A. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.

B. Provide three (3) copies of the manufacturer's representative's certification.

3.05 TRAINING

A. The Contractor shall provide a training session for owner's representatives as requested by the Owner or Engineer.

B. A manufacturer's qualified representative shall conduct the training session.

C. The training program shall consist of the following:

1. Review of the MCC one-line drawings and schedules.

2. Review of the factory record shop drawings and placement of the various cells.

3. Review of each type of starter cell, components within, control, and power wiring.

4. Review contactor coil replacement and contact replacement procedures.

5. Discuss the maintenance timetable and procedures to be followed in an ongoing maintenance program.

6. Provide three-ring binders to participants complete with copies of Drawings and other course material covered.

3.06 EXAMINATION

A. Provide overload relay heater ratings that are properly sized and coordinated for each motor starter unit.

B. Verify NEC clearances as dictated on the contract drawings prior to installation. Verify UL labeling of the assembly prior to installation.

-END OF SECTION-

SECTION 16165

VARIABLE FREQUENCY DRIVES

PART 1 -- GENERAL

1.01 FURNISHING OF EQUIPMENT

A. Unless specifically noted otherwise, variable frequency motor drives for all equipment requiring them shall be furnished under this section. The drive manufacturer shall furnish all required controls as specified herein and as functionally required by the instrumentation and controls section.

B. The manufacturer shall be Square D Altivar 660 or Ativar 320 Process Drive series. No equal.

C. Provide Altivar 660 drives with necessary modifications to provide a two second power loss ride through.

D. Provide all drives with conventional analog and digital control interface for control. Provide Ethernet TCP/IP network communications for monitoring to the plant control system for Altivar 660 VFD's.

E. Provide equipment purchased from the manufacturer's representative authorized to represent the manufacturer in the projects territory, Lee County Florida.

F. The manufacturer shall factory fabricate the drive cabinets to match the plan lineup and available space indicated

1.02 DESCRIPTION OF SYSTEM

A. Factory-assembled, metal-enclosed VFD motor control units for distribution and control of power from incoming line terminals to outgoing feeder terminals, installed and tested in place. Where shown on drawings, furnish and install VFD units in freestanding NEMA 12 gasketed, ventilated and filtered motor control cabinets as herein specified. The motor control shall be supplied from a 3-phase, 3-wire 60 cycle power system as shown. A U.L. label shall be provided on each Section indicating compliance with UL Standards. The adjustable frequency drives and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of ETL, UL, ANSI, and NEMA.

B. VFD Motor Control Units shall include all protective devices and equipment as listed on drawings or as included in these specifications, with necessary interconnections, instrumentation, and control wiring.

C. The VFD manufacturer shall be responsible for providing a system for the specific installation intended, including considerations of conductor distances from the drive to the motor. Each VFD drive shall include an output dv/dt filter system within the VFD cabinet to limit voltage peak and voltage rise time at the motor terminals. The filters must limit the voltage rise time and voltage peak at the motor terminals to those required by NEMA MG1-1993, Section IV, Part 30 with voltage peak less than 1000 volts and rise time greater than 2 microseconds.

1.03 QUALITY ASSURANCE

A. Reference Standards:

1. American National Standard Institute (ANSI):

a. ANSI Y32.2 1975, Graphic Symbols for Electrical and Electronic Diagrams.

b. ANSI Z55.1 1967 (R1973) Gray finishes for Industrial Apparatus and Equipment.

2. National Electrical Manufacturers Association (NEMA):

a. NEMA ICS 1, 2, 3, 4, 5, 6, controls and systems.

3. National Fire Protection Association (NFPA):

a. NFPA 70 2008, National Electric Code (NEC).

b. NFPA-70E-2009 Standard for Electrical Safety in the Workplace.

4. Underwriters' Laboratories, Incorporated (UL):

a. UL Electrical Construction Materials List, motor controllers motor-control centers (NJAV), (HJOT) and (NLDX).

1.04 SUBMITTALS

A. Product Data:

1. Layouts showing concrete pad dimensions, conduit entrance and available space, bus duct connections, electrical ratings, nameplate nomenclature, and single-line diagrams in accordance with ANSI Y32.2 indicating connections and controls with numbered terminals.

2. Frame sizes and Interrupting Capacity of unit.

3. Horsepower rating and rated voltage of unit.

4. Manufacturer's written recommendation for storage and protection, installation instructions and field test requirements.

5. Manufacturer's instructions for tightening bus connections, performing cleaning, and operating and maintaining motor control unit.

6. Submit written verification that overall dimensions are within the maximum dimensions indicated on plans.

7. Submit manufacturer’s recommended spare parts list.

B. Shop Drawings:

1. Complete master wiring diagrams, elementary schematics and control schematics shall be submitted for approval before proceeding with manufacture. Suitable outline drawings shall be furnished as part of this submittal. Standard or typical pre-printed sheets or drawings simply marked to indicate applicability to this contract will not be acceptable. Shop drawings shall be job specific.

2. A complete drawing indicating each point of interface with the process control system and the type of signal provided or accepted at each point.

3. A complete drive programmer’s manual.

4. A drawing showing the layout of the VFD local control panel indicating every device mounted on the door with complete identification.

5. Provide shop drawings on 11" X 17" paper and drawn with a computer aided design (CAD) package. The computer aided design package shall be Autocad or converted to Autocad format. Submittals shall include hard copy and CD-ROM media electronic copies (dwg format).

1.05 WARRANTY

A. The equipment manufacturer shall provide a two year warranty from initial startup and demonstration of the complete automatic controlled drive pump system to the engineer. The equipment manufacturer shall guarantee that the equipment furnished is suitable for the purpose intended and free from defects of design, material and workmanship. In the event the equipment fails to perform as specified, the equipment manufacturer shall promptly repair or replace the defective equipment without any costs to the owner (including labor, transportation, handling and shipment costs). Warranty shall not cover damage to the equipment caused by external sources and operator errors; however the units shall be protected from power line surges and electrical fault conditions and therefore the warranty shall apply to power line transient surge, ground faults, line to line faults, EMI and RFI interference and other external electrical disturbance caused damage.

B. The VFD manufacturer shall maintain as part of a national network, engineering service facilities within 150 miles of the project to provide start-up service, emergency service calls, repair work, and service contracts.

1.06 SPARE PARTS

A. Provide spare parts as follows: one set of all fuse types, one each type relay, SPD, Phase Monitor, 2 sets of replacement filters, one complete set of VFD inverter fans and VFD enclosure fans, one set of pilot lights (LED type), one of each type thermal module or switch. In addition provide circuit boards for: Gate Interface Board, PreCharge Board, Power Interface Board, Control Board, Power Module, Heatsink Fan, HIM module. Provide one spare of all I/O and dual port Ethernet/IP DLR communications boards.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Provide 75hp and above VFD's as manufactured by Square D Altivar 660 Process Drive series with clean power drive. Provide 20hp and below VFD's as manufactured by Square D Altivar 320 Process Drive series with clean power drive. Provide clean power controller utilizing a front end MTE Matrix broadband filter with harmonic cancellation techniques. The VFD shall contain a built in cut-out circuit to automatically take the filter offline on low power loads. Provide Ethernet communications capability. Provide hard wired control where shown on the drawings.

B. The VFDs shall be of the Pulse Width Modulated (PWM) design converting the utility input voltage and frequency to a variable voltage and frequency output via a three step operation. Adjustable Current Source VFDs are not acceptable. IGBT type Transistors shall be used in the inverter section. GTOs and SCRs are not acceptable. The VFDs shall be current regulated. VFDs permitting instantaneous over current trips other than for output short circuit are not acceptable.

C. All VFDs shall utilize a vector torque control strategy to regulate motor flux to optimize motor torque without the need for encoders. VFDs requiring voltage, dwell and current adjustments to achieve improved torque control are not acceptable.

D. The manufacturer shall supply variable frequency drives compatible with the pump motors for operation of these motors at motor full load amps. The drives shall vary the output frequency from minimum to maximum pump speed typically 6-60hz.

E. The drive shall be of sufficient capacity and provide a quality of output waveform so as to achieve full rated and continuous output of the pump motor. All drives shall be factory built-up units complete with all necessary and specified components, as hereinafter defined, which shall be supplied by the drive manufacturer as a unit. Each built-up drive shall be tested by the drive manufacturer prior to shipment from the factory and a certificate of the test provided.

2.02 ENVIRONMENTAL CONDITIONS

A. The drive shall accept plant power nominal AC voltage of 480V AC +10% -10%, 3 phase, 60 Hertz + 3%.

B. The operating ambient condition shall have a temperature range of 0 to 40 degrees Celsius with a relative humidity of up to 95% (non-condensing).

2.03 CONSTRUCTION TECHNIQUES

A. The drive shall be of modular design to provide for ease and speed of maintenance including removal of modules, with one maintenance technician.

B. All components shall be mounted in a NEMA type 12, gasketed, ventilated and filtered enclosure properly sized to dissipate the heat generated by the power electronics. The enclosure shall be painted with corrosion resistant coatings with finish paint of ANSI 49 Gray. Ether top or bottom entry of cables shall be permitted.

C. The DC bus shall be filtered by series inductor & capacitors to provide ripple free dc.

D. Circuit breakers. The operating mechanism shall be designed so that the door can be padlocked in the "Off" position. Protection for the VFD's power circuit shall be provided by use of circuit breakers and type "J" input fuses.

E. The drive shall meet any one of the following standards; CSA, ETL, UL.

F. All VFD's must be tested/run under load until rated operating temperatures is achieved.

G. Provide VFDs with shock hazard shielding methods for all exposed terminals, bus bars and termination points. The low voltage terminals, buss bars, lugs etc. shall be physically guarded, insulated and/or isolated to insure safety to maintenance personnel and for reduced arc flash hazard.

H. Provide VFDs with approved ventilation air filter frame mounting and hardware assemblies.

I. The VFD shall be furnished with a diagnostic indicator to show low bus/line and high bus/line voltage conditions, timed current overload and inverter output fault. Drive ready and Drive run status indication shall be standard.

2.04 ACCESSORIES

A. The Altivar 660 unit shall include an incoming, UL listed, circuit breaker. A three position switch (hand-off-auto) mounted on the controller door provides manual selection of local or auto control. The "Hand" position allows manual local keypad run/stop and speed control of the VFD; the speed control shall be via a keypad mounted on the door calibrated from 0-100% speed. The door of the VFD cabinet shall contain but not be limited to the following devices:

1. Key Pad and alpha numeric displays providing programming and manual control of the drive.

2. VFD fault indicating light.

3. Hand auto switch.

4. Power On indicating light.

5. VFD Run indicating light.

6. Motor High Temperature indicating light.

7. Process parameter control indicating light (Ex: Low Level shutdown).

B. The Altivar 320 unit shall include a dial and escape button mounted on the unit drive to navigate the menus and set drive speed control calibrated from 0-100% speed. The unit shall contain but not be limited to the following devices:

1. Integrated Alpha numeric displays providing programming and manual control of the drive.

2. VFD fault indicating light.

3. VFD Run indicating light.

C. Provide 24Vdc logic module and 24Vdc power supply within the drive to hold the drive logic active during power interruptions.

2.05 OPERATING CHARACTERISTICS

A. The variable frequency drive shall convert single or 3 phase, 60 Hertz input power to an adjustable frequency and voltage (from 6 Hertz to 60 Hertz with a frequency stability of +/- 1% of setting) for controlling the speed of AC induction motors. The converter will be of the voltage source design using current controlled PWM techniques. The input power factor of the drive shall be a minimum of .95 at all speeds and loads.

B. The output voltage shall vary proportionally with the output frequency to maintain a constant volts/Hertz value up to nominal frequency. Above nominal frequency, the output voltage shall remain constant.

C. The modulating control scheme shall closely approximate actual sine wave current throughout the speed range of the drive. The regulator shall be fully digital with microprocessor control of frequency, voltage, and current. The frequency resolution of the drive shall be .01 Hertz. All drive adjustments and custom programming shall be capable of being stored in a non-volatile memory (EEPROM).

D. Current limit. A current limit circuit shall be provided to limit motor current to a preset adjustable maximum level by reducing the drive operating speed or acceleration rate when the limit is reached. Range of adjustment shall be from 50 to 115%.

E. The power unit's logic common shall be at ground potential.

F. Short circuit and ground fault protection. The VFD shall have an instantaneous electronic trip circuit to protect the VFD from output line-to-line and line-to-ground short circuits. The VFD must be capable of withstanding without damage to the VFD, short circuits at 480V plus 10% (528V). Opening of the VFD's input and/or output line switches during drive operation shall not result in damage to the drive.

G. The VFD shall be capable of providing 110% motor name plate service factor current for one minute. The VFD shall include an instantaneous overcurrent trip. The VFD shall not restart after electronic overcurrent trip until manually reset. Except for overcurrent, the drive will first attempt to restart on the inverter up to a maximum of three times on "Auto-Restart" before faulting out and waiting for operator reset.

H. Altivar 660 Power loss ride-through. The VFD shall be capable of continued operation during an intermittent loss of power for 2.0 second (120 cycles). The essential drive and pump relay logic integrated within the drive shall be powered through the 24VDC VFD power source during the power interruption for the 2 second duration. The VFD drive will resume normal operation within 0.5sec if power is reapplied during the 2 second ride through duration.

I. Auto restart after power outage. The VFD shall be capable of starting into a spinning motor. The VFD shall be able to determine the motor speed in any direction and resume operation without tripping. If the motor is spinning in the reverse direction, the VFDs shall start into the motor in the reverse direction, bring the motor to a controlled stop, and then accelerate the motor in the preset method of starting.

J. Transient and surge voltage protection. Transient and surge voltage protection shall be provided through use of Metal Oxide Varistors (MOV's) and phase-to-ground filter capacitors.

K. Auto restart after fault. The VFD shall automatically attempt to restart after a malfunction or an interruption of power. If the drive reaches the limit of restarts without successfully restarting and running for 90 seconds, the restart circuit shall lockout and drop out the fault relay. Two Form C contacts shall be provided.

L. Motor overload protection. Provide electronic motor overload and single phase protection integral to the inverter.

M. Frequency jump points: Provide (3) selectable frequency jump points in 1.0hz increments, to be used to avoid critical resonance frequencies of the mechanical system.

N. Application programming dedicated to pumps.

1. The VFD shall provide Pump Control & Monitoring Functions for Centrifugal pump characteristics and configurations.

    a. Pump monitoring function in order to define data relevant for pump (acceleration, low speed, high speed, etc.)

    b. Application Units function in order to define units used in applications.

    c. Pump Cyclic Start Protection in order to protect the pump against too many restarts in a dedicated time period.

    d. Multi-pump functions.

2. The VFD shall provide Pump Protection Functions

   a. Anti-Jam function in order to remove automatically clogging substances from the pump impellers.

   b. Pipe Cleaning function in order to start pump regularly to avoid sedimentation in pump impeller

   c. Cavitation Pump Protection

   d. Inlet protection in order to avoid system dry running.

3. The VFD shall provide Application control functions

   a. Stop and Go function in order to reduce consumption of VFD in case of pump inoperation.

   b. Pipe Fill function in order to manage a smooth control during pipe filling and to lessen the effects of water hammer.

   c. Sleep wake-up function in order to manage periods of the application when process demand is low and when it is not needed.

   d. Low demand function in order to define periods of the application when process demand is low in order to save energy.

4. The VFD shall provide Pump curve input to help optimize pump performance.

   a. Input and storage of the pump characteristics including 5 points of the pump curve.

   b. A best efficiency point (BEP) function in order to run in optimum conditions and detect deviation from this point.

2.06 CONTROLS

A. Provide an operator panel with a detachable UL Type 12/IP65 rated bi-color backlit graphical user interface terminal with keypad and capacitive wheel for monitoring, annunciation, and configuration for Altivar 660 VFD. The graphical display shall change to a red backlit color when an alarm occurs. The display provides indication of any selected drive functions; speed, load, motor volts, motor amps, diagnostic information, programming functions, etc. The keypad provides a means of programming and manually controlling the drive. Programming only keypads are not acceptable. The key pad shall be used to input the following setup adjustments:

   1. Minimum speed, 1 to 85%

   2. Maximum speed, 50 to 100%

3. Linear accel, 2-25 seconds

4. Maximum output voltage, adjustable

5. Volts/Hertz, adjustable.

6. Local setpoint reference.

7. Current Limit Setpoint.

8. Selectable carrier frequencies, V/Hz, and critical frequency avoidance lockout.

9. Multiple attempt restarts

B. Remote Controls: The VFD drives shall be hardwired to the plant control system as detailed on the single line drawing. The Ativar 660 VFD drives shall have a dedicated Ethernet connection to the plant control system with all parameters within the drive accessible to the control system. As a minimum provide the following inputs and outputs for remote operator control from the plant computer system.

1. Drive Digital inputs

   a. Start/Stop

   b. Drive Reset

2. Drive Digital outputs

   a. VFD in remote and Ready.

   b. Drive running

   c. VFD internal fault.

   d. VFD external fault

3. Analog inputs/outputs

   a. Motor speed feedback output

   b. Remote speed Setpoint input

C. Internal Control Wiring: Each control wiring conductor shall have heat shrink identification labels on each end of termination. Terminations shall be made to screw terminal strips. All points of terminal strips are to be labeled to match conductor labeling.

PART 3 -- EXECUTION

3.01 INSPECTION

A. Examine area to receive motor-control units to assure adequate clearance for motor control unit installation. Check that concrete pads are level and free of irregularities for motor control centers.

B. All workmanship utilized in the manufacture and installation of this system shall be of the highest quality and performed in a manner which is consistent with all accepted practices for industrial controls.

C. The supplier shall construct and verify proper operation of the assembled system under simulated conditions with motors of similar characteristics; before shipment to the site.

3.02 INSTALLATION

A. Install motor control units in accordance with manufacturer's written instructions, and NEC.

B. The installing contractor shall guarantee that installation of the system is in accordance with the manufacturer's instructions.

3.03 START UP SUPERVISION AND TRAINING

A. The system supplier shall provide a factory trained and authorized service technician to inspect all final connections and check the system prior to start up of the pump drive system. The service technician shall coordinate with the systems integrator for complete functional check out of the system. The factory authorized person shall provide written certification that the installation meets or exceeds all factory recommendations for proper operation.

B. Copies of the Operating and Maintenance manuals shall be prepared specifically for this installation and shall include all required specification sheets, drawings, equipment lists, descriptions, etc. that are required to instruct operating and maintenance personnel unfamiliar with such equipment.

C. A factory representative who has complete knowledge of proper operation and maintenance shall be provided for training to instruct representatives of the owner and the Engineer in proper operation and maintenance. Training subjects shall include, operator training, system repair, maintenance and detailed software training. Training shall be conducted after system startup, testing, and control tuning procedures are complete, and before final completion. If there are difficulties in operation of the equipment due to the installation or fabrication, additional instruction days shall be provided as deemed necessary by the engineer and at no cost to the owner.

-END OF SECTION-

SECTION 16170

DISCONNECTS & SAFETY SWITCHES

PART 1 -- GENERAL (NOT USED)

PART 2 -- PRODUCTS

2.01 GENERAL

A. All single throw disconnect switches and double throw manual transfer switches shall be heavy-duty horsepower rated type. Safety switches shall be rated for the available fault current where installed. Provide enclosed molded case switch type disconnects where required to meet high available fault current areas (above 10kaic). Switches shall be fusible only where required to meet equipment nameplate requirements.

B. Switches shall be 240 volt rated on systems up to and including 120/208V and 600V rated on higher voltage systems. All switches for motors shall be horsepower rated. All switches shall be NEMA 4X stainless steel enclosure except switches mounted in air-conditioned spaces. As an alternate to NEMA 4X stainless steel enclosure provide NEMA 4X switches with aluminum enclosure as manufactured by Bryant. As an alternate to NEMA 4X stainless steel enclosures provide polyglass enclosures for 30amp (10hp) switches in the chemical areas equal to Hubbell Circuit-Lock.

C. Provide and install lugs on disconnect switch as required to accept conductors called for on drawings.

D. Provide Switches with an externally operated handle; quick make quick break mechanism; the handle shall be interlocked with the switch cover by means of a defeatable interlock device. The switch shall be lockable in the "off" position with a padlock. Switches shall have arch suppressors, pin hinges and be horsepower rated at 600 volts.

E. All disconnect switches shall be furnished from the manufacturer with (2) normally open and (2) normally closed interlock contacts. Motor space heater shall be wired through one set of contacts. The other contact shall be wired through the local off/remote motor switch at the disconnect location.

F. Double throw non-fused safety switches may be used for manual power transfer where shown on the drawings and in areas up to 10,000A available short circuit current. In areas above 10k amps use double throw molded case manual transfer switches rated for the available fault currents.

2.02 SUBMITTALS

A. Submit product data on all major types of disconnects.

PART 3 – EXECUTION

3.01 INSTALLATION

A. All three phase motors shall be provided with field mounted disconnects if they are not mounted within site of the three phase feeder breaker or control device they are wired from.

B. With the safety switch in the open position, both the motor heater and power circuits shall be open as well.

C. Provide all motor disconnects with an auxillary Off/Remote maintained hand switch to disable the control power circuit.

-END OF SECTION-

SECTION 16180

CIRCUIT BREAKERS AND FUSIBLE SWITCHES – LOW VOLTAGE

PART 1 -- GENERAL(NOT USED)

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

A. Provide Cutler Hammer, Square-D or GE circuit breakers to match equipment provided. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions.

2.02 POWER CIRCUIT BREAKERS

A. Provide power circuit devices, type low-voltage power circuit breakers, Square D type MasterPact NW or approved equal. Frame ratings shall be 800, 1600, 2000, 3200, 4000 amperes. All breakers shall be UL listed for application in their intended enclosures for 100% of their continuous ampere rating.

B. Breakers shall be manually operated (MO) or electrically operated (EO) as indicated on the drawings.

C. Electrically operated breakers shall be complete with close/open pushbuttons control switch], plus red and green indicating lights to indicate breaker contact position 120 Vac motor operators; the charging time of the motor shall not exceed 6 seconds. Source voltage shall be taken from a control power transformer internal to the switchgear assembly.

D. All circuit breakers shall have a minimum symmetrical interrupting capacity of 65,000amperes or higher where shown on the drawings. To ensure a selective system, all circuit breakers shall have 30-cycle short-time withstand ratings equal to their symmetrical interrupting ratings through 85,000 amperes, regardless of whether equipped with instantaneous trip protection or not.

E. All power circuit breakers shall be constructed and tested in accordance with ANSI C37.13, C37.16, C37.17, C37.50, UL 1066 and NEMA SG-3 standards. The circuit breakers shall carry a UL label.

F. Provide units Arc Flash Reduction Maintenance Remote accessory as specified in Paragraph 2.03. The Arc Flash Reduction Maintenance Remote shall allow the operator to enable a maintenance mode with a preset accelerated instantaneous override trip to reduce arc flash energy.

G. To facilitate lifting, the power circuit breaker shall have integral handles on the side of the breaker. The power circuit breaker shall have a closing time of not more than 3 cycles. The primary contacts shall have an easily accessible wear indicator to indicate contact erosion.

H. The power circuit breaker shall have three windows in the front cover to clearly indicate any electrical accessories that are mounted in the breaker. The accessory shall have a label that will indicate its function and voltage. The accessories shall be plug and lock type and UL listed for easy field installation. They shall be modular in design and shall be common to all frame sizes and ratings.

I. The breaker control interface shall have color-coded visual indicators to indicate contact open or closed positions as well as mechanism charged and discharged positions. Manual control pushbuttons on the breaker face shall be provided for opening and closing the breaker. The power circuit breaker shall have a “Positive On” feature. The breaker flag will read “Closed” if the contacts are welded and the breaker is attempted to be tripped or opened.

J. The current sensors shall have a back cover window that will permit viewing the sensor rating on the back of the breaker. A rating plug will offer indication of the rating on the front of the trip unit.

K. A position indicator shall be located on the faceplate of the breaker. This indicator shall provide color indication of the breaker position in the cell. These positions shall be Connect (Red), Test (Yellow), and Disconnect (Green). The levering door shall be interlocked so that when the breaker is in the closed position, the breaker levering-in door shall not open.

L. Each power circuit breaker shall offer sixty (60) front mounted dedicated secondary wiring points. Each wiring point shall have finger safe contacts, which will accommodate #10 AWG maximum field connections with ring tongue or spade terminals or bare wire.

1. include an optional provision for key locking open to prevent manual or electric closing. Padlocking shall secure the breaker in the connected, test or disconnected position by preventing levering

2.03 TRIP UNITS

A. Each low-voltage power circuit breaker and insulated case circuit breaker shall be equipped with a solid-state tripping system consisting of three current sensors, microprocessor-based trip device and flux-transfer shunt trip. Current sensors shall provide operation and signal function. The trip unit shall use microprocessor-based technology to provide the basic adjustable time-current protection functions. True rms sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time delay settings are reached. Interchangeable current sensors with their associated rating plug shall establish the continuous trip rating of each circuit breaker. The trip unit shall Square D Micrologic P with MODBUS communication module.

B. The trip unit shall have an information system that provides LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A reset button shall be provided to turn off the LED indication after an automatic trip.

C. The trip unit shall be provided with a display panel, including a representation of the time/current curve that will indicate the protection functions. The unit shall be continuously self-checking and provide a visual indication that the internal circuitry is being monitored and is fully operational.

D. The trip unit shall be provided with a making-current release circuit. The circuit shall be armed for approximately two cycles after breaker closing and shall operate for all peak fault levels above 25 times the ampere value of the rating plug.

E. Trip unit shall have selectable thermal memory for enhanced circuit protection.

F. The trip unit shall provide zone interlocking for the short-time delay and ground fault delay trip functions for improved system coordination. The zone interlocking system shall restrain the tripping of an upstream breaker and allow the breaker closest to the fault to trip with no intentional time delay. In the event that the downstream breaker does not trip, the upstream breaker shall trip after a preset time delay. Factory shall wire for zone interlocking for the power circuit breakers within the switchgear.

G. The trip unit shall have an information system that utilizes battery backup LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A test pushbutton shall energize a LED to indicate the battery status.

H. The trip unit shall be equipped to permit communication via Modbus to the switchgear Allen Bradley Compactlogix PLC system provided in the equipment for remote monitoring and control. All monitored parameters shall be transmitted.

I. The trip unit shall include a power/relay module, which shall supply control power to the readout display. Following an automatic trip operation of the circuit breaker, the trip unit shall maintain the cause of trip history and the mode of trip LED indication as long as its internal power supply is available. An internal relay shall be programmable to provide contacts for remote ground alarm indication.

J. The trip unit shall include a voltage transformer module, suitable for operation up to 600V, 50/60 Hz. The primary of the power relay module shall be connected internally to the line side of the circuit breaker through a dielectric test disconnect plug.

K. The display for the trip units shall be a 24-character LED display.

L. Metering display accuracy of the complete system, including current sensors, auxiliary CTs, and the trip unit, shall be +/- 1% of full scale for current values. Metering display accuracy of the complete system shall be +/- 2% of full scale for power and energy values.

M. The unit shall be capable of monitoring the following data:

1. Instantaneous value of phase, neutral and ground current

2. Instantaneous value of line-to-line voltage

3. Minimum and maximum current values

4. Watts, vars, VA, watthours, varhours, and VA hours, Peak demand, Present demand,Energy consumption.

5. Crest factor, power factor, percent total harmonic distortion, and harmonic values of all phases through the 31st harmonic.

N. An adjustable high load alarm shall be provided, adjustable from 50 to 100% of the long delay pickup setting.

O. The trip unit shall contain an integral test pushbutton. A keypad shall be provided to enable the user to select the values of test currents within a range of available settings. The protection functions shall not be affected during test operations. The breaker may be tested in the TRIP or NO TRIP test mode.

P. Programming may be done via a keypad at the faceplate of the unit or via the communication network.

Q. System coordination shall be provided by the following microprocessor-based programmable time-current curve shaping adjustments. The short-time pickup adjustment shall be dependant on the long delay setting.

1. Programmable long-time setting

2. Programmable long-time delay with selectable I2t or I4t curve shaping

3. Programmable short-time setting

4. Programmable short-time delay with selectable flat or I2t curve shaping, and zone selective interlocking

5. Programmable instantaneous setting

6. Programmable ground fault setting trip or ground fault setting alarm

7. Programmable ground fault delay with selectable flat or I2t curve shaping and zone selective interlocking

R. The trip unit shall offer a three-event trip log that will store the trip data, and shall time and date stamp the event.

S. The trip unit shall have the following advanced features integral to the trip unit:

1. Adjustable undervoltage release

2. Adjustable overvoltage release

3. Reverse load and fault current

4. Reverse sequence voltage alarm

5. Underfrequency

6. Overfrequency

7. Voltage phase unbalance and phase loss during current detection

T. The main breakers fitted with trip units shall be provided with an Arcflash Reduction Maintenance System Technology capability. The Arcflash Reduction Maintenance System shall allow the operator to enable a maintenance mode using a remote control which enables a preset accelerated instantaneous override trip to reduce arc flash energy. A blue LED on the trip unit shall indicate the trip unit is in the maintenance mode

2.04 MOLDED CASE CIRCUIT BREAKERS – 800 A AND BELOW

A. Protective devices shall be molded case circuit breakers with inverse time and instantaneous tripping characteristics and shall be Eaton or approved equal.

B. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be nonwelding silver alloy and arc extinction shall be accomplished by means of DE-ION arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.

C. Circuit breakers shall have a minimum symmetrical interrupting capacity as indicated on the drawings.

D. Circuit breakers 400ampere frame and below shall be have thermal-magnetic trip units and inverse time-current characteristics.

E. Circuit breakers 800ampere through 1200-ampere frame shall have microprocessor-based rms sensing trip units.

2.05 QUICK-MAKE/QUICK-BREAK FUSIBLE SWITCHES

A. Protective devices shall be quick-make/quick-break fusible switches. Fusible switches 30 amperes through 600 amperes frames shall be furnished with rejection Class “R” or “J” type fuse clips unless otherwise scheduled. Fusible switches 800 amperes through 1200 amperes shall be furnished with Class L fuse clips. Switches shall incorporate safety cover interlocks to prevent opening the cover with the switch in the ON position or prevent placing the switch in the ON position with the cover open. Provide defeater for authorized personnel. Handles shall have provisions for padlocking and shall clearly indicate the ON or OFF position. Front cover doors shall be padlockable in the closed position.

PART 3 -- EXECUTION(NOT USED)

-END OF SECTION-

SECTION 16190

SUPPORTING DEVICES

PART 1 -- GENERAL

1.01 SCOPE

A. The work under this sections includes conduit and equipment supports, straps, clamps, steel channel, etc, and fastening hardware for supporting electrical work. Furnish and install all supports, hangers and inserts required to mount fixtures, conduit, cables, pull boxes and other equipment furnished under this Division. All supporting devices and hardware exterior of buildings or interior of structures except in air conditioned spaces shall be stainless steel. Aluminum and nonmetallic supports (fiberglass) and hardware will be reviewed by the Engineer on a case-by-case basis.

B. All items shall be supported from the structural portion of the building. Supports and hangers shall be of a type approved by Underwriters' Laboratories. Wire shall not be used as a support. Boxes and conduit shall not be supported or fastened to ceiling suspension wires or to ceiling channels.

C. The Contractor shall furnish and install all sleeves that may be required for openings through floors, wall etc. Where plans call for conduit to be run exposed, the Contractor shall furnish and install all inserts and clamps for the supporting of conduit. If the Contractor does not properly install all sleeves and inserts required, contractor to provide cutting and patching to the satisfaction of the Engineer.

1.02 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.

1. Section 16110– Conduit Systems

1.03 SUBMITTALS: PRODUCT DATA

A. Provide data for support channel.

1.04 QUALITY ASSURANCE

A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

PART 2 -- PRODUCTS

2.01 MATERIAL

A. Support Channel: Stainless steel throughout except galvanized steel in conditioned interior areas.

B. Hardware: Stainless steel throughout

C. Minimum sized threaded rod for supports shall be 3/8”.

D. Conduit clamps, straps, supports, etc., shall be stainless steel or aluminum. One-hole straps shall be heavy duty type.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. All steel conduits shall be securely fastened in place on maximum of 6 foot intervals; all PVC conduits shall be securely fastened in place on maximum of 3 foot intervals vertically and 2 foot intervals horizontally. Hangers, supports or fastenings shall be provided at each elbow and at the end of each straight run terminating at a box or cabinet. The required strength of the supporting equipment and size and type of anchors shall be based on the combined weight of conduit, hanger and cables. Horizontal and vertical conduit runs may be supported by two-hole malleable straps, clamp-backs, or other approved devices with suitable bolts, expansion shields (where needed) or beam-clamps for mounting to building structure or special brackets.

B. On concrete or masonry construction, use "Tapcon" type fasteners. For brick construction, insert anchors shall be installed with round head machine screws. In wood construction, round head screws shall be used. An electric or hand drill shall be used for drilling holes for all inserts in brick, concrete or similar construction. Steel members shall be drilled and tapped, and round head machine screws shall be used. All screws, bolts, washers, etc., used for supporting conduit or outlets shall be fabricated from stainless steel, or approved substitution.

C. Fasten hanger rods, conduit clamps, outlet, junction and pull boxes to building structure using preset inserts, beam clamps, expansion anchors, or spring steel clips (interior metal stud walls only). Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchors on concrete surfaces; sheet metal screws in sheet metal studs and wood screws in wood construction.

D. File and de-bur cut ends of support channel and spray paint with cold galvanized paint to prevent rusting. Do not fasten supports to piping, ductwork, mechanical equipment, cable tray or conduit. Do not drill structural steel members unless approved by the engineer.

E. Fabricate supports from 316 stainless steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts. Install surface-mounted cabinets and panelboards with minimum of four anchors. Provide steel channel supports to stand cabinet one inch (25 mm) off wall.

F. Furnish and install all supports as required to fasten all electrical components required for the project, including free standing supports required for those items remotely mounted from the building structure, catwalks, walkways etc.

-END OF SECTION-

SECTION 16265

UTILITY TO UTILITY TRANSFER SWITCH

PART 1 -- GENERAL

1.01 GENERAL

A. Automatic transfer switches shall be furnished as shown on plans, with full load current and voltage rating as shown, normal and emergency. The transfer switch shall be capable of switching all classes of load, and shall be rated for continuous duty when installed in a non-ventilated enclosure NEMA ICS 6 or 3R that is constructed in accordance with Underwriters' Laboratories, Inc., Standard UL 1008. Provide transfer switches by the genset manufacturer or as indicated on the Drawings. The generator set manufacturer shall warrant transfer switches to provide a single source of responsibility. Transfer switches shall be rated to carry 100 percent of rated current continuously in the enclosure supplied, in ambient temperatures of 40 to +60 degrees C, relative humidity up to 95 percent (non condensing).

B The transfer switch shall be provided in a NEMA 12 (interior installation locations) or NEMA 4X stainless steel (exterior installation locations) wall mounted enclosure with a continuous hinge, gasketed and a 3 point latch. HMI deadfront mounted through enclosure door shall be fitted with a hinged window kit, Schaefer's SPHWKSS-(###)-BC or approved equal.

C. Provide complete factory assembled power transfer equipment with field programmable digital electronic controls designed for fully automatic operation and including: surge voltage isolation, voltage sensors on all phases of both sources, linear operator, permanently attached manual handles, positive mechanical and electrical interlocking, and mechanically held contacts for both sources.

D. Transfer switch equipment shall have withstand and closing ratings (WCR) in RMS symmetrical amperes greater than the available fault currents. Contractor to verify available fault currents.The transfer switch and its upstream protection shall be coordinated. The transfer switch shall be third party listed and labeled for use with the specific protective device(s) installed in the application.

E. Transfer switches shall be double throw, electrically and mechanically interlocked, and mechanically held in the source 1 and source 2 positions. The transfer switch shall be specifically designed to transfer to the best available source if it inadvertently stops in a neutral position. Transfer switches shall be equipped with permanently attached manual operating handles and quick break, quick make over center contact mechanisms. Transfer switches over 1000 amperes shall be equipped with manual operators for service use only under de energized conditions. The transfer switch shall be configurable to control the operation time from source to source (program transition; delayed transition operation). Sync checked two position transfer switches without delayed transition are not acceptable

F. The transfer switch shall be capable of transferring successfully in either direction with 90 percent of rated voltage applied to the switch terminals. Transfer switches that are designated on the Drawings as 3-pole shall be provided with a neutral bus and lugs. The neutral bus shall be sized to carry 100 percent of the current designated on the switch rating. Transfer switch shall be provided with copper long barrel Hi-Press lugs sized to accept the full output rating of the switch. Lugs shall be suitable for the number and size of conductors shown on the Drawings.

G. Operator Panel: Each transfer switch shall be provided with a control panel to allow the operator to view the status and control operation of the transfer switch The operator panel shall be provided with the following features and capabilities.

1. High intensity LED lamps to indicate the source that the load is connected to (source 1 or source 2); and which source(s) are available. Source available LED indicators shall operate from the control microprocessor to indicate the true condition of the sources as sensed by the control. High intensity LED lamps to indicate that the transfer switch is “not in auto” (due to control being disabled or due to bypass switch (when used) enabled or in operation) and “Test/Exercise Active” to indicate that the control system is testing or exercising the generator set.

2. “OVERRIDE” pushbutton to cause the transfer switch to bypass any active time delays for start, transfer, and retransfer and immediately proceed with its next logical operation. “TEST” pushbutton to initiate a preprogrammed test sequence for the generator set and transfer switch. The transfer switch shall be programmable for test with load or test without load. “RESET/LAMP TEST” pushbuttons that will clear any faults present in the control, or simultaneously test all lamps on the panel by lighting them.

3. The control system shall continuously log information on the number of hours each source has been connected to the load, the number of times transferred, and the total number of times each source has failed. This information shall be available via the operator display panel.

4. Analog AC meter display panel, to display 3-phase AC Amps, 3-phase AC Volts, Hz, KW load level, and load power factor. The display shall be color-coded, with green scale indicating normal or acceptable operating level, yellow indicating conditions nearing a fault, and red indicating operation in excess of rated conditions for the transfer switch.

H. Provide for utility to utility ATS dry maintained contact input/output from the facility control system. I/O List to the plant controls:

Digital inputs:

ATS not in Auto

Preferred source Supplying Load

Alternate source Supplying Load

Power Failure

1.02 TWO SOURCE MANUAL BYPASS: (BYPASS ISOLATION)

A. Where shown on the Drawings, provide integral to the transfer switch assembly a transfer switch bypass and associated isolation equipment. The bypass isolation switch shall provide a means for manually bypassing the transfer switch from either source (Normal or Emergency) to the load, while under load if necessary, and to isolate the transfer switch from both sources for maintenance or repair. Designs that bypass to only one source are not acceptable.

B. Bypass isolation switch equipment shall be UL Listed per Standard 1008, CSA Approved; with continuous current rating, voltage and frequency ratings, and withstand and closing ratings equal to the transfer switch ratings at the specified conditions of ambient temperature, humidity. The bypass isolation and transfer switches shall be mechanically held in each position. Switching mechanisms shall be break before make on all poles, including the neutral pole on four pole switches. The switch mechanism shall be an over center toggle device which provides stored energy contact operation during both opening and closing. The speed of contact operation shall be independent of the force applied to the operating handles, which permit manual operation under load. Bypass switch shall be a fully rated manually operated switch, rated for the same loads as the automatic transfer switch.

C. Bypass switch shall provide bypass to either normal or emergency source by use of a door mounted keyed source selector switch and a permanently mounted external-operating handle.

D. Positive mechanical interlocks shall prevent all possible source to source interconnections. Designs which depend on electrical interlocks to prevent source to source interconnections are not acceptable.

E. A drawout isolation mechanism shall provide closed-door isolation of the transfer switch, using a permanently mounted, external handle. The isolation mechanism shall be interlocked so that either the transfer switch must be bypassed or the transfer switch must be open, before the mechanism will permit isolation of the transfer switch. Mechanisms that do not allow for drawout and removal for servicing are not acceptable.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.01 QUALITY ASSURANCE/TESTS

A. As a precondition for approval, transfer switch, complete with timers relays and accessories shall be listed by Underwriters' Laboratories, Inc. in their Electrical Construction Materials Catalog under Standard UL 1008 (automatic transfer switches) and approved for use on emergency systems.

B. When conducting temperature rise tests to paragraph 99 of UL 1008 the manufacturer shall include post-endurance temperature rise tests to verify the ability of the transfer switch to carry full rated current after completing the overload and endurance tests.

C. Electrical Field Tests: Field testing shall be preformed prior to substantial completion.

1. Perform insulation resistance tests phase-to-phase and phase-to-ground with switch in both source positions.

2. Perform a contact resistance test across all main contacts.

3. Verify settings and operation of control devices in accordance with the specifications provided by the manufacturer.

4. Calibrate and test all relays and timers including voltage and frequency sensing relays, in phase monitor (synchronism check), engine start and cool-down timers, transfer and retransfer timers, etc.

5. Perform automatic transfer tests: Simulate loss of normal power. Test Return to normal power. Simulate loss of emergency power. Simulate all forms of single phase conditions. Monitor and verify correct operation and timing of the following simulations: Normal voltage-sensing relays: Engine start sequence: Time delay upon transfer: Alternate voltage-sensing relays: Automatic transfer operation: Interlocks and limit switch function: Time delay and retransfer upon normal power restoration: Engine cool-down and shutdown feature.

6. System Function Tests: Perform system function tests upon completion of equipment tests. It is the purpose of system function tests to prove the proper interaction of all sensing, processing, and action devices.

a. Develop test parameters for the purpose of evaluating performance of all integral components and their functioning as a complete unit within design requirements.

b. Test all interlock devices.

c. Record the operation of alarms and indicating devices.

3.02 SHOP DRAWINGS

A. Submit Shop Drawings and product data clearly indicating:

1. Cabinet dimensions.

2. All applicable options and accessories.

3. Wiring diagrams.

4. Interrupting or withstanding current rating.

5. All electrical characteristics and data as required showing compliance with these specifications.

6. Digital Metering device and wiring.

-END OF SECTION-

SECTION 16430

UNDERGROUND DUCTS AND DUCTBANKS

PART 1 -- GENERAL

1.01 Provide underground duct banks for power and lighting feeders; instrumentation and control systems as shown or as specified herein; from point of service switchgear or equipment to the point of distribution or equipment served.

1.02 SUBMITTALS

A. Submit shop drawings or cut sheets on

1. Conduit

2. Fittings

3. Conduit Separators

4. PVC solvent

5. Precast concrete manholes

6. Composite handholes

7. Cable lubricants

1.03 DESCRIPTION OF ASSEMBLY

A. Underground duct banks shall be multiple individual conduits encased in reinforced concrete as indicated on the drawings. Conduits within building or structural foundations and protected by a concrete slab above them do not require encasement (except provide encasement or flowable fill under electrical and pump room slabs). The conduit shall be of plastic (PVC sch 40 for concrete encasement and Sch80 without concrete encasement), unless indicated or specified otherwise. The conduit used shall not be smaller than 4 inches in diameter, inside, unless otherwise noted. The concrete encasement surrounding the duct bank shall be rectangular in cross-section, having a minimum concrete thickness of three inches around all conduits. All concrete encased duct banks shall be steel reinforced as detailed. Power distribution conduits shall be separated by a minimum dimension of four inches and not less than 7.5" center to center. Power conduits shall be separated from low voltage instrumentation & control conduits by a minimum dimension of twenty four inches.

B. The concrete work shall conform to Section on "Concrete". The top of the concrete envelope shall be not less than 24 inches below grade unless otherwise indicated. Concrete shall be installed in a continuous pour to eliminate joints in the duct run. The duct bank sides shall be formed in place using suitable concrete form work or corrugated metal forms. Open trench pours will not be allowed.

C. Plastic conduit, fittings and joints shall not have been stored in the sun or weather, in any excessively heated space, or unevenly supported during storage. Use and installation shall be in accordance with the National Electrical Code requirements for the installation of non-metallic rigid conduit. Plastic conduit shall be protected against the direct rays of the sun prior to installation. Conduit shall be PVC schedule 40 manufactured by Carlon, Queen City Plastics, or approved substitution. Conduit shall be U.L. listed and conform to NEMA Standards for schedule 40 PVC conduit.

D. Trenches for duct banks shall be completely dry before setting conduits or pouring concrete. Provide well pointing as required if necessary to keep trench dry.

E. Wires and cables in manhole/handhole shall be placed on cable racks. Manhole/handhole shall be cleaned of all loose materials, dirt and debris immediately after completion of new work and shall be in a clean condition when project is completed. Cable racks shall be stainless steel or non metallic with stainless steel hardware, cable racks shall be complete with insulators. Racks shall be Underground Devices or approved substitution.

F. Back filling of trenches shall be in layers not more than 8 inches deep, and shall be thoroughly tamped. The first layer shall be earth or sand, free from particles that would be retained on a 1/4 inch sieve. The succeeding layers shall be excavated material having stones no larger than would pass through a 4-inch ring. The back fill shall be level with adjacent surface, except that in sodded or paved areas, a space equal to the thickness of the sod or paving shall be left.

G. The surface disturbed during the installation of duct shall be restored to its original elevation and condition if not refinished in connection with site work.

H. All unused conduit openings shall be plugged or capped with a suitable device designed for the purpose; caulking compound shall not be used for plugging conduit openings.

I. One No. 2 bare solid tinned copper counterpoise shall be run above all duct banks and shall be run into all manholes/handholes and grounded to 5/8" X 20' driven ground rods. Counterpoise shall run into buildings and be grounded at each structures service ground.

J. All conduits entering a building or structure shall be sealed with duct seal.

PART -- 2 PRODUCTS

2.01 DUCT BANK STRUCTURES

A. Precast Concrete Construction: Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast manholes and pullboxes.

1. General: Concrete for precast work shall have an ultimate 28-day compressive strength of not less than 4000 psi. Structures may be precast to the design and details indicated precast monolithicly and placed as a unit, or structures may be assembled sections, design and produced by the manufacturer in accordance with the requirements specified. Structures shall be identified with the manufacturer's name embedded in or otherwise permanently attached to an interior wall face.

2. Construction: Structure top, bottom and wall shall be of a uniform thickness of not less than 4 inches. Quantity, size, and location of duct bank entrance windows shall be as required, and cast completely open by the precaster. Size of windows shall exceed the nominal duct bank envelope dimensions by at least 12 inches vertically and horizontally to preclude in-field window modifications made necessary by duct bank misalignment. However, the sides of precast windows shall be a minimum of 6 inches from the inside surface of adjacent walls, floors, or ceilings. Form the perimeter of precast window openings to have a keyed or inward flared surface to provide a positive interlock with the mating duct bank envelope. Provide welded wire fabric reinforcing through window openings for in-field cutting and flaring into duct bank envelopes. Provide additional reinforcing steel comprised of at least two No. 4 bars around window openings. The minimum concrete cover for reinforcing steel shall be 2 inches. Provide drain sumps for precast structures a minimum of 12 inches in diameter and 6 inches deep.

3. Joints: Provide tongue-and-groove or shiplap joints on mating edges of precast components. Design joints to firmly interlock adjoining components and to provide waterproof junctions and adequate shear transfer. Seal joints watertight using preformed plastic strip conforming to AASHTO M198, Type-B. Install sealing material in strict accordance with the sealant manufacturer's printed instructions. Provide waterproofing at conduit/duct entrances into structures, and where access frame meets the top slab, provide continuous grout seal.

B. Precast Concrete manholes and pullboxes (handholes): ASTM C 478. Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete manholes and pullboxes. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. Locate duct entrances and windows near the corners of structures to facilitate cable racking. Metal Covers shall fit the frames without undue play. Form steel and iron to shape and size with sharp lines and angles. Castings shall be free from warp and blow holes that may impair strength or appearance. Exposed metal shall have a smooth finish and sharp lines and arises. Provide necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete. Install a pulling-in iron in the wall opposite each duct line entrance. Cable racks, including rack arms and insulators, shall be adequate to accommodate the cable.

C. Metal Frames and Covers: Shall be made of cast iron. Covers shall weight a minimum 100lb. Frames and covers of steel shall be welded by qualified welders in accordance with standard commercial practice. Covers shall have raised letters of identification as indicated on the drawings. Covers shall have an approved antislip surface. Covers shall be rated AASHTO H20.

D. Pulling-In Irons: Shall be steel bars bent cast in the walls and floors. In the floor they shall be centered under the cover and in the wall they shall be not less than 6 inches above or below, and opposite the conduits entering the manhole or pullbox. Pulling-in irons shall project into the box approximately 4 inches. Iron shall be hot-dipped galvanized after fabrication.

E. Cable Racks: Rack arms and insulators, shall be sufficient to accommodate the cables. Racks in manhole and pullbox shall be spaced not more than 2 feet apart, and each box wall shall be provided with a minimum of two racks. The wall bracket shall be stainless steel or fiberglass. Slots for mounting cable rack arms shall be spaced at 8-inch intervals. The cable rack arms shall be of stainless steel or fiberglass and shall be of removable type. Insulators shall be dry-process glazed porcelain. All metal fasteners and hardware portion of racks shall be stainless steel.

F. Grounding in manholes and pullboxes: Provide No. 6 AWG bare copper grounding pigtails on walls of each manhole and pullbox. The pigtails shall be exothermically welded to the reinforcing bars and shall extend at least 8 inches into box. Two pigtails shall be provided in each box.

G. Pull Wire: Plastic rope having a minimum tensile strength of 200 pounds in each empty duct. Leave a minimum of 24 inches of slack at each end of the pull wires.

H. Composite Handholes: Only where composite handholes are indicated on the drawings, use handholes, covers and boxes of polymer concrete as manufactured by Quazite Corporation. The material shall consist of aggregate bound together with a polyester resin and reinforced with continuous woven glass strands. The covers and boxes shall be designed to be installed flush to grade with cover fitting flush to the box and shall be capable of withstanding normal shipping and installation process without chipping, cracking or structural damage. All boxes shall be manufactured with the use of male/female molds to ensure a consistent wall thickness and structural strength and shall be stackable or extra depth. The boxes and covers shall have dimensions as indicated and shall be concrete gray in color. The cover logo shall be recessed into the cover and shall read INSTRUMENTATION or ELECTRIC as indicated. The composite covers shall be designed for a static vertical load of 8,000 pounds and shall be tested, in the box, to a static load of 12,000 pounds (1.5 safety factor). The test load shall be distributed over a 10 inch by 10 inch by 1 inch thick distribution plate located at the center of the cover. The maximum deflection at a load of 8,000 pounds shall not exceed 0.50 inches. The covers shall be skid resistant and have a minimum coefficient of friction of 0.50 on the top surface for the life of the cover. Coatings will not be provided. The permanent deflection of any surface shall not exceed 10% of the maximum allowable test load deflection. The lockdown mechanism shall be capable of withstanding a minimum torque of 30 foot-pounds. All inserts and fasteners shall be of stainless steel.

PART 3 -- EXECUTION

3.01 INSTALLATION: conform to NFPA 70 and ANSI C2.

A. The top of the conduit shall be not less than 24 inches below grade, for low voltage conduits and 48 inches for high voltage ducts. Run conduit in straight lines except where a change of direction is necessary. Provide not less than 3 inches clearance from the conduit to each side of the trench. A minimum clearance of 2 1/2 inches shall be provided between adjacent conduits. Grade bottom of trench smooth; where rock, soft spots, or sharp-edged materials are encountered, excavate the bottom for an additional 3 inches, fill and tamp level with original bottom with sand or earth free from particles, that would be retained on a 1/4 inch sieve.

B. Precast manhole and pullbox Installation: Commercial precast assembly shall be set on 6 inches of level, 90 percent compacted granular fill, 3/4-inch to 1-inch size, extending 12 inches beyond the manhole or pullbox on each side. Granular fill shall be compacted by a minimum of four passes with a plate type vibrator.

C. Buried Warning and Identification Tape: Metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3-inch-minimum width, color coded as specified below for the intended utility and warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

Warning Tape Color Codes

Yellow or red:	Electric power
Orange:	Instrumentation and Control

D. Conduit Placement: Duct lines shall have a continuous slope downward toward manholes/handholes and away from buildings with a pitch of not less than 3 inches in 100 feet. Except at conduit risers, accomplish changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, by long sweep bends having a minimum radius of curvature of 25 feet. Manufactured bends may be made up or one or more curved or straight sections or combinations thereof. Manufactured bends shall have a minimum radius of 18 inches for use with conduits of less than 3 inches in diameter and a minimum radius of 36 inches for ducts of 3 inches in diameter and larger.

E. Termination and Cleaning of Conduit: Terminate conduits in end-bells where duct lines enter manholes and pullboxes. Separators shall be of precast concrete, high impact polystyrene, steel, or a combination of these. Stagger conduit joints by rows and layers to provide a duct line having the maximum strength. During construction, protect partially completed duct lines from the entrance of debris such as mud, sand, and dirt with suitable conduit plugs. As each section of a duct line is completed, draw a non-flexible testing mandrel not less than 12 inches long with a diameter 1/4 inch less than inside diameter of the conduit through the conduit. After which, draw a stiff bristle brush having the same diameter of the duct through the duct, until duct is clear of particles of earth, sand, and gravel; then immediately install end plugs.

F. Conduit Protection at Concrete Penetrations: Conduits which penetrate concrete (slabs, pavement, and walls) shall be galvanized rigid steel; protected by a PVC sheath at the penetration; PVC sheath shall be 40-mils thick conforming to NEMA RN 1, and shall extend from at least 2 inches below the concrete to the first coupling or fitting outside the concrete (minimum of 6 inches above concrete).

G. Cable Pulling: Pull Cables down grade with the feed-in point at the manhole or pullbox or point of the highest elevation. Use flexible cable feeds to convey cables through box opening and into duct runs. Accumulate cable slack at each box where space permits by training cable around the interior to form one complete loop. Maintain minimum allowable bending radii in forming such loops.

H. Cable Lubricants: Use lubricants that are specifically recommended by the cable manufacturer for assisting in pulling jacketed cables. Cable lubricants shall be soapstone, graphite, or talc for rubber or plastic jacketed cables. Lubricant shall not be deleterious to the cable sheath, jacket, or outer coverings.

I. Cable Pulling Tensions: Tensions shall not exceed the maximum pulling tension recommended by the cable manufacturer.

J. Installation of Cables in manholes and pullboxes and Handholes: Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths. Form cables to closely parallel walls, not to interfere with duct entrances, and support on brackets and cable insulators at a maximum of 18 inches. Support cable splices in underground structures by racks on each side of the splice. Locate splices to prevent cyclic bending in the spliced sheath. Install cables at middle and bottom of cable racks, leaving top space opening for future cables, except as otherwise indicated for existing installations.

K. FIREPROOFING OF CABLES IN MANHOLES: All wire and cables in manholes shall be fireproofed. Strips of fireproofing tape approximately 1/16 inch thick by 3 inches wide shall be wrapped tightly around each cable spirally in one-half lapped wrapping, or in two butt-jointed wrappings with the second wrapping covering the joints in the first. The tape shall be applied with the coated side toward the cable, and shall extend one inch into the ducts. To prevent unraveling, the fireproofing (Arc-proofing) tape shall be random wrapped with tape conforming to type FGT of specification MIL-I-15126. The fireproofing (arc proofing) tape shall consist of a flexible, conformable fabric having one side coated with a flame-retardant, flexible, polymeric coating and/or a chlorinated elastomer. The tape shall not be less than 0.050 inch thick, and shall weigh not less than 2.5 pounds per square yard. The tape shall be non-corrosive to cable sheath, shall be self-extinguishing, and shall not support combustion. The tape shall not deteriorate when subjected to oil, water, gases, saltwater, sewage and fungus. The tape shall have a tensile strength of not less than 40 pounds per inch width, and when tested under USA Standard L14.184 cut strip method. Provide certification the product retains 65 percent of its original tensile strength for the following tests for 168 hours for each requirement;

1. Immersion in distilled water,

2. Immersion in 3 percent salt water,

3. Exposure to ultra-violet light (30-watt germicidal lamp),

4. Exposure to sunlight (Type S-1 sun lamp), and exposure to concentrated sewage

-END OF SECTION-

SECTION 16450

GROUNDING AND BONDING

PART 1 -- GENERAL

1.01 DESCRIPTION; the terms “connect”, “ground” and “bond” are used interchangeably in this specification and have the same meaning

A. This section specifies general grounding and bonding requirements of electrical equipment operations and to provide a low impedance path for possible ground fault currents.

B. “Grounding electrode system” refers to all electrodes required by NEC, as well as including made, supplementary, perimeter counterpoise ground, lightning protection system grounding electrodes.

1.02 RELATED WORK

A. Section 16050 Basic Material and Methods.

B. Section 16051 Special Electrical Requirements.

B. Section 16120, Low Volt. Wires and Cables.

C. Section 16610, Lightning Protection Systems

1.03 SUBMITTALS

A. Submit in accordance with Section 16050

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.

2. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.

C. Test Reports: Provide certified test reports of ground resistance.

D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the Project Engineer:

1. Certification, by the Contractor, that the complete installation has been properly installed and tested.

1.04 APPLICABLE PUBLICATIONS

A. American Society for Testing and Materials (ASTM):

B. Institute of Electrical and Electronics Engineers, Inc. (IEEE): Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

C. National Fire Protection Association (NFPA): National Electrical Code (NEC) 2008

D. Underwriters Laboratories, Inc. (UL):

Thermoset-Insulated Wires and Cables

Thermoplastic-Insulated Wires and Cables

Grounding and Bonding Equipment

Wire Connectors

PART 2 -- PRODUCTS

2.01 GROUNDING AND BONDING CONDUCTORS

A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 2 AWG and smaller may be solid copper unless noted otherwise noted on the drawings. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 4 AWG and larger shall be permitted to be identified per NEC.

B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 2 AWG and smaller may be ASTM B1 solid bare copper wire.

C. Electrical System Grounding: Conductor sizes shall not be less than what is shown on the drawings and not less than required by the NEC, whichever is greater.

2.02 SPLICES AND TERMINATION COMPONENTS

A. Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

2.03 GROUND CONNECTIONS

A. Above Grade:

1. Bonding Jumpers: compression type connectors, using zinc-plated fasteners and external tooth lock washers.

2. Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.

PART 3 -- EXECUTION

3.01 GENERAL

A. Ground in accordance with the NEC, as shown on drawings, and as hereinafter specified. Minimum size #12AWG.

B. System Grounding:

1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.

2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.

C. Equipment Grounding: Metallic structures (including ductwork and building steel), enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.

D. Provide conduit sleeves for all bare equipment ground conductors stubbing through concrete.

3.02 GROUNDING CONNECTIONS

A. Make grounding connections that are below grade by exothermic weld. Make grounding connections that are above grade but are otherwise normally inaccessible (poured columns, within walls) with exothermic weld.

3.03 SECONDARY EQUIPMENT AND CONNECTIONS

A. Transformers:

1. Exterior: Exterior transformers supplying interior service equipment shall have the neutral grounded at the transformer secondary. Provide a grounding electrode at the transformer.

2. Separately derived systems (transformers downstream from service equipment): Ground the secondary neutral at the transformer. Provide a grounding electrode conductor from the transformer to the ground bar at the service equipment.

B. Conduit Systems:

1. Ground all metallic conduit systems. All conduit systems shall contain an equipment grounding conductor (except service entrance with grounded neutral). Ground conductor shall be bonded to metallic conduit systems at the entrance and exit from the conduit.

C. Boxes, Cabinets, Enclosures, and Panelboards:

1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes.

2. Provide lugs in each box and enclosure for equipment grounding conductor termination.

3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.

E. Motors and Starters: Provide lugs in motor terminal box and starter housing or motor control center compartment to terminate equipment grounding conductors.

F. Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.

3.04 CORROSION INHIBITORS

A. When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.05 CONDUCTIVE PIPING

A. Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system.

3.06 GROUND RESISTANCE

A. Grounding system resistance to ground shall not exceed 2 ohms. Make necessary modifications or additions to the grounding electrode system for compliance without additional cost to the owner. Final tests shall assure that this requirement is met.

B. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

C. Below-grade connections shall be visually inspected by the Project Engineer prior to backfilling. Provide ground inspection wells at all ground rod locations.

3.07 GROUND ROD INSTALLATION

A. Drive or drill each rod vertically in the earth, not less than 20 feet in depth.

B. Where permanently concealed ground connections are required, make the connections by the exothermic process to form solid metal joints. Make above grade accessible ground connections with mechanical pressure type ground connectors.

C. Where rock prevents the driving of vertical ground rods, drill rock then install rod. Backfill with flowable fill or concrete mix. Obtain the necessary permits if required for drilling.

-END OF SECTION-

SECTION 16460

LOW-VOLTAGE TRANSFORMERS

PART 1 -- GENERAL

1.01 DESCRIPTION-this section specifies the furnishing, installation and connection of the dry type general-purpose transformers.

1.02 RELATED WORK

A. Section 16051, Special Requirements for Electrical Installations:

B. Section 16110, Conduit Systems:

C. Section 16120, Low-Voltage Wire and Cables

D. Section 16450, Grounding and Bonding

1.03 SUBMITTALS

A. In accordance with Section 16050 Basic Electrical Materials and Methods.

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.

2. Include electrical ratings, impedance, dimensions, weight, mounting details, decibel rating, terminations, temperature rise, no load and full load losses, and connection diagrams.

3. Complete nameplate data including manufacturer's name and catalog number.

C. Manuals:

1. Submit, simultaneously with the shop drawings, companion copies of

complete maintenance and operating manuals including technical data sheets and wiring diagrams.

1.04 REFERENCES

A. National Fire Protection Association (NFPA) 70-08 National Electrical Code (NEC)

B. National Electrical Manufacturers Association (NEMA): ST 20-97 Dry-Type Transformers for General Applications

PART 2 -- PRODUCTS

2.01 GENERAL PURPOSE DRY TYPE TRANSFORMERS

A. Unless otherwise specified, dry type transformers shall be in accordance with NEMA, NEC and as shown on the drawings. Transformers shall be UL listed or labeled.

B. Dry type transformers shall have the following features:

1. Self-cooled by natural convection, isolating windings, indoor, dry type. Autotransformers will not be accepted.

2. Rating shall be as shown on the drawings. Ratings shown on the

drawings are for continuous-duty without the use of cooling fans.

3. Transformers shall have copper windings.

4. Insulation systems:

a. Transformers 30 KVA and larger: UL rated 220 degrees C system having an average maximum rise by resistance of 150 degrees C in a maximum ambient of 40 degrees C.

b. Transformers below 30 KVA: Same as for 30 KVA and larger or UL rated 185 degrees C system having an average maximum rise by resistance of 115 degrees C in a maximum ambient of 40 degrees C.

5. Core and coil assemblies:

a. Rigidly braced to withstand the stresses caused by short circuit currents and rough handling during shipment.

b. Cores shall be grain oriented, non-aging, and silicon steel.

c. Coils shall be continuous windings without splices except for taps.

d. Coil loss and core loss shall be minimum for efficient operation.

e. Primary and secondary tap connections shall be brazed or pressure type.

f. Coil windings shall have end fillers or tie downs for maximum strength.

6. Certified sound levels determined in accordance with NEMA, shall not exceed the following:

Transformer Rating	Sound Level Rating
0 - 9 KVA	40 dB
10 - 50 KVA	45 dB
51 - 150 KVA	50 dB
151 - 300 KVA	55 dB
301 - 500 KVA	60 dB

7. Nominal impedance shall be as per NEMA.

8. Single phase transformers rated 15 KVA through 25 KVA shall have two, 5 percent full capacity taps below normal rated primary voltage. All transformers rated 30 KVA and larger shall have two, 2-1/2 percent full capacity taps above, and four, 2-1/2 percent full capacity taps below normal rated primary voltage.

9. Core assemblies shall be grounded to their enclosures by adequate flexible ground straps.

10. Enclosures:

    a. Not less than code gage steel.

    b. Outdoor enclosures shall be NEMA 4X stainless steel powder coated white or NEMA 3R stainless steel painted grey.

    c. Temperature rise at hottest spot shall conform to NEMA Standards, and shall not bake and peel off the enclosure paint after the transformerhas been placed in service.

    d. Ventilation openings shall prevent accidental access to live components.

    e. Thoroughly clean and paint enclosure at the factory with manufacturer's prime coat and standard finish.

11. Standard NEMA features and accessories including ground pad, lifting provisions and nameplate with the wiring diagram and sound level indicated on it.

12. Dimensions and configurations shall conform to the spaces designatedfor their installations.

13. Transformers shall meet the minimum energy efficiency values per NEMA TP1 as listed below:

kVA Rating	Output efficiency (%)
15	97
30	97.5
45	97.7
75	98
112.5	98.2
150	98.3
225	98.5
312	98.6

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Installation of transformers shall be in accordance with the NEC, as recommended by the equipment manufacturer and as shown on the drawings.

B. Install the transformers with adequate clearance at a minimum of 4 inches from wall and adjacent equipment for air circulation to remove the heat produced by transformers.

C. Install transformers on vibration pads designed to suppress transformer noise and vibrations.

D. Use flexible metal conduit to enclose the conductors from the transformer to the raceway systems.

-END OF SECTION-

SECTION 16501

LIGHTING FIXTURES

PART 1 -- GENERAL

1.01 DESCRIPTION

A. Description of System

1. Light fixtures furnished under this Division shall be furnished complete with lamps and all necessary trim and mounting hardware, and installed as shown on the drawings.

2. Light fixtures shall be neatly and firmly mounted, using standard supports for outlets and fixtures. See special mounting requirements as detailed on the drawings.

3. Lamps shall be included in the system guarantee for a period of ninety (90) days after final acceptance of the building.

1.02 CODES

A. The WORK of this Section shall comply with the current editions of the following codes

1. National Electrical Code (NEC), NFPA 70

2. Florida Building Code (FBC)

1.03 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section

1. UL Underwriters Laboratories

2. CBM Certified Ballast Manufacturer's Association

1.04 SUBMITTALS

A. Shop Drawings and manufacturers data shall be submitted for the following items

1. Luminaire data shall show full-size cross sections. Indicate finished dimensions, metal thickness, U.L. Label, finish, lens/louver thickness and materials.

2. Show mounting details, including hung ceiling construction.

3. Indicate type of ballast and manufacturers and ballast quantity and location. Include information as to power factor, input watts and ballast factor.

4. Indicate lamps to be utilized and quantity.

5. Include a complete listing of all luminaries on a single sheet. This listing shall contain the luminaire type, manufacturer's catalog number, applied voltage, lamps, ballast type and luminaire quantities.

6. The Engineer reserves the right to require submittal of a complete sample fixture for any fixture type.

7. For exterior post/pole mounted light fixtures, clearly indicate hand hole and lightning protection ground lug mounted to post/pole at hand hole inside post/pole.

8. Signed and sealed shop drawings and calculations shall be submitted for all exterior pole mounted fixtures. The seal must be of a registered professional engineer certifying that the foundation and pole/fixture assembly meets or exceeds the wind load criteria of the most current Florida Building Code. The foundation details shown on the plans are for bidding purposes only; the contractor shall provide the foundation and pole assembly necessary for compliance as submitted at no additional cost to owner.

9. Product data shall be submitted showing manufacturer's written recommendations for storage and protection, and installation instructions.

PART 2 -- PRODUCTS

2.01 APPROVED MANUFACTURERS

A. Luminaires

1. Acceptable manufacturers are listed in the lighting fixture schedule shown on the Drawings.

2. The designations indicated on the lighting fixture schedule are a design series reference (not necessarily a complete catalog number) and do not necessarily represent the number, size, voltage, wattage, type of lamp, ballast, finish trim, ceiling type, mounting hardware of special requirements as specified hereinafter on as required by the particular installation(s) and code. Contractor shall verify these requirements and order fixtures as required to give proper installation per the contract documents and per codes.

B. Ballasts

1. It is preferred that all ballasts shall be of the same manufacturer. Every effort shall be made to eliminate ballasts from multiple manufacturers. Ballasts within luminaires of a given type must however be of the same manufacturer. Multiple manufacturers will not be permitted.

2. Approved Manufacturers:

a. Motorola

b. Advance Transformer Co.

c. Magnetek

d. General Electric

C. Lamps

1. All lamps shall be of the same manufacturer. Multiple manufacturers are not permitted.

2. Approved Manufacturers:

a. General Electric

b. Philips

c. Osram Sylvania

2.02 MATERIALS

A. All lighting fixtures mounted outdoors subject to dampness and insects shall have gasketing material between lens door and frame to completely seal interior of fixture. Knockouts and holes in fixtures housing shall be closed and sealed. All fixtures shall be complete with lamps, shielding brackets, concrete bases, anchor bolts, and all necessary fittings and accessories for a complete installation.

B. Plastic Lenses and diffusers:

1. Virgin acrylic unless otherwise noted. Install and leave with no finger prints or dirt marks on the lens or diffuser. Lenses shall be provided on all recessed metal halide luminaires.

2. Minimum unpenetrated thickness for Parabolic or conical element diffuser: 0.085 inch.

3. Minimum nominal thickness: 0.125 inch.

C. Parabolic Luminaire Care: Parabolic luminaires to be installed with mylar cover over louvers. Cover shall be U.L. listed for temporary lighting. Upon completion of work, remove mylar cover with white gloves and blow clean reflectors.

D. Finish: Porcelain or baked enamel finish matte white on interiors with minimum tested reflectance of 90 percent matte white finish or as specified in visible exterior. Thoroughly clean base metal and painted after fabrication.

E. Sockets: Incandescent lamp sockets - porcelain housings over copper screw shells, with medium base sockets rated at 660 watts and 250 volts. Insulating joint in pull chains. Fluorescent lampholder - white, rotor lock, heat-resistant plastic rated 660 watts and 600 volts. Fluorescent industrial sockets - heavy-duty, multi-socket, metal-clad, spring-loaded. Provide heavy-duty sockets for H.I.D. luminaires where mounted less than 8'-0" AFF.

F. Luminaire Wiring: Minimum individual luminaire wiring - number 18 gauge with insulation at rated operating temperature of 105 degrees Centigrade or higher. Terminate wiring for recessed luminaires, except fluorescent units, in an external splice box.

G. Ballasts

1. Ballasts for F32T8 lamps shall be:

   a. High frequency solid state electronic.

   b. Electronic Program start

   c. 50 F minimum starting temperature unless otherwise noted

   d. Minimum 1.15 ballast factor

   e. Maximum total harmonic distortion (THD) less than 10%

   f. High power factor, minimum 95 %

   g. Sound rated A

2. High-power factor (over 90 percent). Certified Ballast Manufacturers' Certification, ballast case temperature not to exceed 90 degrees Centigrade during normal operation in 30 degrees Centigrade ambient temperature. Ballast voltage: 120 or 277 volts, as required by circuiting. Ballast shall be provided with the best sound rating available.

3. Built-in self-resetting thermal actuated device will remove ballast from line when excessive ballast temperature is reached. U.L. Class P, CBM certified 100% output.

4. The conductors between ballasts and lampholders shall have an approved insulation for 1,000 volts. This includes conductors to and from remote ballasts.

5. High-intensity discharge ballasts shall be constant wattage autotransformer type with built-in thermal protection, minimum power factor of 80%. 12" min. leads.

6. Provide ballasts with voltage characteristics to match that of all related circuitry indicated on the Drawings. No extra compensation will be allowed for failure to properly coordinate ballast voltage with circuitry.

7. Ballasts for control of lamps in one housing or fixture unit may control lamps of an adjoining unit, except as otherwise noted.

8. Guarantee ballast for one full year and one year prorated as per standard manufacturer's warranty against defects for a period of 2 years. Guarantee to include replacing defective ballast with new ballast.

9. Provide dimming ballasts as shown on the drawing for fixtures controlled by individual dimming or dimming systems.

10. LED drivers for interior luminaires shall employ an auto resetting thermal management system to turn off the LED array when normal operating temperatures are exceeded. Exterior drivers shall employ a step reduction circuit to reduce lumen output in order to maintain proper operating temperatures, but will not allow an “off” condition for thermal management.

H. Lamps

1. Provide a complete set of new lamps in each fixture.

2. Unless noted otherwise lamps must conform to the following:

a. Fluorescent: T-8, 41k color. Minimum of 80 CRI and 3100 lumens.

b. Incandescent: "A" lamps to be inside frosted rated at 130 volts.

c. Compact Fluorescent: triple Twin tube, 4-pin

d. HID: Metal Halide, clear, universal base, open rated.

e. LED: Minimum of 50,000 hrs life at no less than 70% initial lumen rating. 40k color. Minimum of 80 CRI. Color variation shall not exceed a 3 step MacAdam ellipse.

I. Luminaires installed recessed in a metal pan ceiling shall have a flange type trim to overlap abutment of adjacent pans.

J. Where utilized as raceways, luminaires shall be suitable for use as raceways. Provide feed through splice boxes where necessary.

K. Where ceiling mounted fixtures are called for in the Light Fixture Schedule and on the drawings, this contractor shall provide fixture trims and supports as required to match type of ceiling system which will be furnished. No ceiling fixtures shall be ordered until the Ceiling System Installer has given written approval of the method and location of fixture hanging and fixture type. Fixtures supported by suspended ceiling systems shall be securely fastened to the ceiling framing member by mechanical means, such as bolts, screws, or rivets. Clips identified for use with the type of ceiling frame member(s) and fixture(s) shall also be permitted. Where fixtures are supported by the suspended ceiling system; the ceiling system shall have a minimum (2) opposite corners tied to structure at each fixture location; this contractor shall be responsible for doing this work or for having the ceiling contractor perform it. All supports shall meet current FBC standards.

L. All exterior post/pole mounted light fixtures shall have a hand hole at the base, lightning protection in hand hole and ground conductor connected to ground rod at base. Hand hole shall provide easy access to light fixture fusing and lightning protection ground lug. Lightning protection ground lug shall be provided inside post/pole, electrically in contact with pole, for connection to ground rod. Provide and install ground wire from ground lug to ground rod, concealing ground wire through post/pole base. Anchor bolts to be galvanized.

M. All interior and exterior light fixtures shall not have any labels exposed to normal viewing angles. This includes manufacturer labels and U.L. labels. All labels shall be concealed within the body of the fixture and/or luminaire. No manufacturers name or logo shall appear on the exterior of any light fixtures unless approved in writing by engineer.

N. All light fixtures shall adhere to U.L. Test Standard #1571 and Section #410-65C of the National Electric Code. All manufacturers shall provide the required thermal protection as required.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Install luminaires in mechanical and unfinished areas after ductwork and piping installation. Adjust fixture locations to provide the best lighting for equipment access and service locations. Locate fixtures 8 feet 6 inches above floor, or at suitable locations within space on walls but not lower than 7'-0" AFF.

B. The Contractor shall protect luminaires from damage during installation of same and up to time of final acceptance. Any broken luminaires, glassware, plastics, lamps, etc., must be replaced by the Contractor with new parts, without any additional expense to the Owner.

C. The contractor shall verify prior to ordering fixtures that each fixture scheduled has correct type trim and support arrangement for the proposed ceiling construction.

D. Install all fixtures in accordance with manufacturer’s written instructions and the NEC.

E. Pendant mounted units shall comply with the following:

1. Each stem shall have a brass or steel swivel or other self-aligning device of type approved by the Engineer. The entire luminaire mounting (hickey, aligner, swivel, stem, etc.) shall be submitted to and approved by the Engineer before installation.

2. An insulated malleable iron bushing shall be placed at luminaire end of stem through which wire passes.

3. A pendant support using an approved sliding clevis bracket which firmly grips an indentation in rigid sides of the wiring channel will be acceptable.

4. Connections between outlet boxes and luminaires shall be by means of approved flexible raceways. The application of raceways directly between luminaires is unacceptable.

F. Where luminaires are mounted upon surface-mounted outlet boxes in surface mounted conduit runs, this Contractor shall furnish and install a luminaire canopy sufficiently deep to permit exposed conduits to pass through. Canopy shall have proper openings cut by luminaire manufacturer through which conduits may pass. Submit sample of canopy for approval before installation.

G. Ceiling surface mounted fluorescent fixtures installed in exposed ceiling areas are to be suspended from ceiling structure with all-thread rods and 1-1/2”x1-1/2” Kindorf channels, full length of fixture/row. Mount outlet box at structure with flexible connection to fixture.

H. Ducseal shall be installed to seal all conduits entering exterior light fixtures from underground.

I. Install exit light as indicated on the drawings but not higher than 10'0" AFF. Size and color of lettering shall comply with local codes.

J. Outdoor lighting shall be aimed in periods of darkness in front of the owner/engineer.

3.02 COORDINATION WITH AMBIENT CONDITIONS

A. The Contractor is responsible for coordinating the characteristics and the U.L. labeling of the luminaires and their components with the ambient conditions which will exist when the luminaires are installed. No extra compensation will be permitted for failure to coordinate the luminaires with their ambient conditions. These areas of coordination include but are not limited to the following:

1. Wet location labels

2. Damp location labels

3. Low temperature ballasts

4. Dimming ballasts

5. Very low heat rise ballasts

6. Explosion proof

7. Plenums and air handling spaces

8. Fire rated ceilings

9. Low density ceilings

10. Insulated ceilings

3.03 CLEAN-UP

A. Luminaires:

1. Clean free from dust and dirt. Wash lens and glassware using cleaner such as “Windex” and dry with absorbent paper. Clean plastic per manufacturer’s recommendations; do not wipe. Lenses which are kept in original containers until immediately prior to final inspection may not require cleaning. Clean “Alzak” aluminum surfaces (reflectors, fixture cones and the like) per mfr’s recommendations being careful to remove finger prints and smudges.

2. It is the contractor’s responsibility to remove any U.L. labels or manufacturer’s labels from areas of fixture exposed to view and relocate label to non-obtrusive area on fixture.

-END OF SECTION-

SECTION 16610

LIGHTNING PROTECTION SYSTEM

PART 1 -- GENERAL

1.01 DESCRIPTION

A. Description of Systems:

1. A Lightning Protection System shall be placed on the structures by experienced installers in compliance with provisions of Code for Lightning Protection Systems as adopted by the National Fire Protection Association and Underwriters' Laboratories. Intent of the lightning protection systems shall be to protect the structures against damage by lightning. All equipment to that result shall be included whether or not specifically called for herein. Installers shall be Underwriters Laboratories certified as Master Label installers or of equal qualifications as approved by Engineer.

2. Provide complete and upgraded lightning protection systems as noted on the drawings. Provide bonding and grounding systems and interconnection to the site lightning protection and grounding systems as shown on the drawings and as specified. All systems shall be in conformance to NFPA-780, UL-96, UL96-A and as shown on the contract drawings.

3. Materials shall comply in weight, size and composition with the requirements of Underwriters' Laboratories and the National Fire Protection Code relating to this type of installation, and shall be U.L. labeled.

4. All installations shall be performed to meet Underwriters Laboratories Master Label standards. Provide a UL Master Label or Lightning Protection Institute (LPI) certification for all protected structures to the extent the structures are eligible under the standards of UL 96A. If the structure is not eligible under the standards of UL 96A, provide a Letter of Findings for the installation at completion of work.

1.02 SUBMITTALS

A. Shop Drawings and Product Data:

1. Shop Drawings: Shop drawings shall be submitted before work is started. Drawings shall include full layout of cabling and points, and connections. The drawing shall show the type, size and location of all equipment, grounds and cable routing. The drawing shall show all grounds and air terminals that are shown on the contract drawings. See additional requirements for shop drawings in section 16050.

2. Product Data: Product Data shall be submitted on all equipment to show compliance with this section of the specifications and shall include manufacturer's written recommendations for installation. Provide a sample of the air terminal to be used with the shop drawing submittal.

3. Provide the owner with 2 spare tubes of the adhesive used to affix bases, fasteners and down conductors to facilities.

1.03 SYSTEM DESIGN

A. The system shall be an effective, aesthetically acceptable streamer delaying lightning protection system to the standards of Underwriters Laboratories UL 96 & UL96A. The purpose of the system shall be to reduce the likelihood of a direct strike to the protected structure by delaying the formation of streamers from that structure. Secondarily the system shall be designed in such a manner that it affords protection to the structure upon which it is installed in the event a direct lightning strike to the structure does occur.

B. The system components shall not require mounting in a specific configuration or impose any other mounting limitations which may interfere with utility use of structure space or otherwise preclude or limit the intended use of the structure.

C. All components shall be attached to the structure in such a manner as to reduce the possibility of corrosion between dissimilar metals. If installed on a metallic or otherwise electrically conductive structure, the system shall be electrically bonded to the structure upon which it is installed through mounting clamps and brackets, with additional bonding to grounded objects and to the structure, as required or as indicated on the drawings.

D. The system shall be composed of components that meet the requirements of Underwriters Laboratories UL 96. Aluminum and Stainless Steel components shall be employed on structures and portions of structures subject to corrosive elements, where the use of copper components could be rendered ineffective, due to the surrounding environment. No dissimilar metals shall be allowed to be in contact. In areas where chemical conditions may deteriorate the specified materials faster than the life expectancy of the material, the LP installer shall bring these conditions to the attention of the engineer prior to installation.

E. Air Terminals shall be mounted on all outside corners of each structure, around the perimeter of each structure at intervals not to exceed twenty (20) feet, and on the interior of each structure in such a manner that no two Air Terminals are separated by a distance of more than fifty (50) feet. In the event this is not practical, such as on a large open tank, Air Terminal spacing around the perimeter shall be decreased to not more than fifteen (15) feet, with a total number around the perimeter not less than the total of the normally required perimeter Air Terminals, plus the additional number of Air Terminals if Air Terminals had been installed on the interior at intervals not greater than fifty (50) feet.

F. Each Air Terminal shall be provided with two (2) contiguous paths to ground. On structures with handrails, exposed structural members, or other conductors, provide a bond to structural conductors from the lightning protection system. Handrails shall not be used as a main lightning protection conductor. Provide a continuous lightning protection conductor parallel with handrails and bond from it to each handrail section and a minimum of 10’ on center. In the case of a structure or a portion of the structure where the structure itself is electrically conductive, such as a light pole, tower, etc, that structure or portion of the structure itself may be employed as part of the lightning protection system, provided it meets the minimum requirements of UL 96 or UL 96A, and down conductors are specifically not required on such structures.

PART 2 -- PRODUCTS AND INSTALLATION

2.01 AIR TERMINALS

A. Air Terminals shall be of the streamer delaying type. Each air terminal shall have a minimum of five hundred dissipater electrode wires, none of which exceed ten thousands of an inch diameter. Electrode material shall be high quality 316 series stainless steel and shall have proper base support for surface on which they are attached, and shall be securely anchored to this surface. Terminals shall project a minimum of 18" above top of object to which attached. Air terminal point must be 3/16 or greater to meet current UL standards.

B. Streamer delaying Air Terminals shall be manufactured by Altec Global or Thompson.

2.02 CONDUCTORS

A. Roof conductors shall consist of rope lay aluminum conductor complying with the weight and construction requirements for Class II lightning protection systems (192,000 CM). Conductors shall be coursed to interconnect with air terminals, and in general, provide a two-way minimum path to ground. The angle of any turn shall not exceed 90 degrees, and shall provide an approximately horizontal or downward course. Down conductors shall be Aluminum and transition to copper 18” minimum above grade. Down conductors shall be installed in PVC conduit and hidden within the structure. Approved bi-metal transitions from aluminum conductors for bonding of aluminum roof structures (exhaust fans, etc.) to copper down conductors shall be provided. Radius of bends shall not be less than 8 inches.

B. Counterpoise loop ground conductors shall be tinned copper and be a minimum size equal to the main roof conductor size (192,000cm) or 4/0.

2.03 FASTENER

A. Conductor fasteners shall be of the same material as the conductor, having ample strength to support conductor. Where fasteners are to be mounted in masonry or structural work, they shall be furnished to the Masonry or Structural Contractor so they may be installed during construction of the project.

B. All fasteners shall be of a heavy-duty double bolted type typically used for Class II lightning protection systems. Conductor to conductor connections shall be through heavy-duty pressure type bolted fasteners. Splice and bimetal connections shall be through four bolt pressure type heavy-duty connectors. Crimp fasteners shall not be used.

C. Dissimilar metals shall not be allowed to be in contact. Aluminum fittings shall be mounted on aluminum where necessary, and bonded to the main system using bi metal connectors. Lead coating shall not be acceptable as a bi metal transition.

D. All mechanical termination points and lugs shall have an anti-corrosive coating applied. In areas subject to chemical corrosion (odor control, degasifiers, chem. Rooms, etc.) apply Glyptal 1201 red enamel coating after termination is made. In other less corrosive areas apply Permatex battery protector sealer (SA-9) or Glyptal 1201 or equal.

E. Lugs for copper cable shall be high copper alloy terminals or stainless steel equal to Burndy type QDA Qiklug. Lugs of aluminum alloy are not acceptable.

2.04 GROUND CONNECTIONS

A. Ground rods shall be installed in the quantities as indicated on the drawings and as required by NFPA-780. Ground rods shall be placed a minimum of two (2) feet from building foundations. In addition to above artificial grounds, one down conductor of each two-path system shall be connected to water piping system with approved water pipe type strap connector. All ground rods shall be 5/8" X 20' copperweld type. All connections made below grade shall be exothermically welded (cadweld) connection and placed in a ground rod inspection well as detailed.

B. Soil type in the area is primarily sand with rock layer below. The rock layers on site will require drilling of ground rod holes. All ground rods shall be installed vertically. After drilling and installation of rod, back fill with sand and hydro compact around rod to provide low resistance to ground.

2.05 GROUND ROD & GROUND SYSTEM TESTING

A. The contractor shall utilize a clamp on ground loop tester during construction to check the system for high resistance connections. The resistance at any point below the air terminal shall be less than 5 ohms. The resistance at grade level on the down conductors should be less than 2 ohms. The contractor shall investigate and correct high resistance readings within the system. Demonstrate to the engineer’s satisfaction with witness testing, provision of a low resistance installation meeting this specification.

B. Provide three point fall of potential ground testing on a minimum of one ground rod on each facility prior to connection to the counterpoise system. As an alternate provide ground rod selective method testing with appropriate ground testers. The complete ground system shall be three point fall of potential tested after completion of work. The system shall be tested at a minimum of three points spaced around the site using the “Tagg Slope” technique. Total grid system grounds should be less than one ohm.

2.06 INSTALLATION

A. Installation shall be made in an inconspicuous manner with conductors coursed to conceal equipment as much as possible. Down conductors shall be concealed within structure, and shall be run in 1" PVC conduit. Surface mount down conductors to existing structures in a neat and workmanlike manner. All metallic equipment within 6 feet of any lightning conductor shall be bonded to conductor. System shall also be tied to the main service electrical ground and other ground systems in the area.

2.07 COORDINATION

A. The installer shall coordinate the lightning protection work to insure a correct, neat, and unobtrusive installation. In normally accessible areas, catwalks, equipment platforms, etc., provide installation without trip hazard. Provide embedded conduit sleeves across access ways for ground conductors. In retrofit projects provide flat copper strap to ground or bond across access ways.

B. Any electrical service grounding system and metallic water service piping to the structure shall be electrically bonded to the lightning protection system.

C. The contractor shall coordinate his work in such a manner as to not interfere with the normal operation of the structure upon which the installation is performed.

2.08 MATERIAL MANUFACTURERS

A. Equipment shall be as manufactured by Altec Global Lighting Protection, Thompson Lightning Protection, Inc. Independent Protection Company, Inc., Heary Brothers Lightning Protection, Harger Lightning Protection or Robbins Lightning Protection.

-END OF SECTION-

SECTION 16709

SURGE PROTECTIVE DEVICES (SPDs)

PART 1 -- GENERAL

1.01 SCOPE

A. The Contractor shall furnish and install the Surge Protective Device (SPD) equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection should be integrated into electrical distribution equipment such as switchgear, switchboards, panelboards, busway (integrated within bus plug), or motor control centers. Refer to related sections for surge requirements in:

1.02 RELATED SECTIONS

A. Section 16910 - Control Panels

B. Section 16134 – Panelboards

C. Section 17000 - Instrumentation and Controls Systems

1.03 REFERENCES

A. SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable UL standard (ANSI/UL 1449 3rd Edition).

B. ANSI/IEEE C62.41.1-2002 – Guide on surge environment in low-voltage (1000 V and less) AC power circuits.

C. ANSI/IEEE C62.41.2-2002 – Recommended practice on characterization of surges in low-voltage (1000 V and less) AC power circuits.

D. ANSI/IEEE C62.45-2002 – Recommended practice on surge testing for equipment connected low-voltage (1000 V and less) AC power circuits.

1.04 SUBMITTALS

A. The following information shall be submitted to the Engineer:

1. Provide verification that the SPD complies with the required ANSI/UL 1449 3rd Edition listing by Underwriters Laboratories (UL).

2. For sidemount mounting applications (SPD mounted external to electrical assembly), electrical/mechanical drawings showing unit dimensions, weights, installation instruction details, and wiring configuration.

B. Where applicable the following additional information shall be submitted to the engineer:

1. Descriptive bulletins

2. Product sheets

C. The following information shall be submitted for record purposes:

1. Final as-built drawings and information for items listed and shall incorporate all changes made during the manufacturing process

1.05 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.06 OPERATION AND MAINTENANCE MANUALS

A. Operation and maintenance manuals shall be provided with each SPD shipped.

1.07 MANUFACTURERS

A. Eaton / Cutler-Hammer products

B. SquareD by Schneider Electric: Surgelogic

C. EDCO

D. Erico

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

PART 2 -- PRODUCTS

2.01 VOLTAGE SURGE SUPPRESSION – GENERAL

A. Electrical Requirements

1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.

2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 115% of the nominal system operating voltage.

3. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.

4. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye	●	●	●	●
Delta	N/A	●	●	N/A
Single Split Phase	●	●	●	●
High Leg Delta	●	●	●	●

5. Nominal Discharge Current (In) – All SPDs applied to the distribution system shall have a 20kA In rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an In less than 20kA shall be rejected.

6. SHORT CIRCUIT CURRENT RATING (SCCR): Per NEC 286.6, the short circuit current rating of the SPD shall be equal to or greater than the available short circuit current at the point where installed

7. ANSI/UL 1449 3rd Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 3rd Edition VPR for the device shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	700	1200	1500
L-L	1200	2000	2500

Modes	240D	480D	600D
L-L; L-G	1200	2000	2500

8. SPDs installed internal to the distribution equipment shall be of the same manufacturer as the equipment. The equipment shall be fully tested and certified to the following UL standards:

   UL 67 = Panelboards

   UL 845 = Motor Control Centers

   UL 857 = Busway

   UL 891 = Switchboards

   UL 1558 = Low Voltage Switchgear

B. SPD Design

1. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

2. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance.

3. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.

4. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:

   a. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.

      i. The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.

   b. Surge Counter – The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location.

   c. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed.

5. Remote Status Monitor: The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.

6. Overcurrent Protection

   a. The SPD shall be designed in a way that it will take itself off-line before any damaging external effects to the suppressor or surroundings will occur.

2.02 SYSTEM APPLICATION

A. The SPD applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies.

B. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum surge current capacity			
Category	Application	Per Phase	Per Mode
C	Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	240kA	120 kA
B	High Exposure Roof Top Locations (Distribution Panelboards)	160 kA	80 kA
A	Branch Locations (Panelboards, MCCs, Busway)	120kA	60 kA

C. SPD Type – all SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

2.03 LIGHTING AND DISTRIBUTION PANELBOARD REQUIREMENTS

A. The SPD application covered under this section includes lighting and distribution panelboards.

1. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.

2. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.

3. The panelboard shall be capable of re-energizing upon removal of the SPD.

4. The SPD shall be interfaced to the panelboard via a direct bus bar connection. Alternately, an SPD connected to a 30A circuit breaker for disconnecting purposes may be installed using short lengths of conductors as long as the conductors originate integrally to the SPD. The SPD shall be located directly adjacent to the 30A circuit breaker.

5. The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.

6. The SPD shall be of the same manufacturer as the panelboard.

7. The complete panelboard including the SPD shall be UL67 listed.

B. Sidemount Mounting Applications Installation (SPD mounted external to electrical assembly)

1. Lead length between the breaker and suppressor shall be kept as short as possible to ensure optimum performance. Any excess conductor length shall be trimmed in order to minimize let-through voltage. The installer shall comply with the manufacturer's recommended installation and wiring practices.

C. Switchgear, Switchboard, MCC and Busway Requirements

1. The SPD application covered under this section is for switchgear, switchboard, MCC, and busway locations.

2. The SPD shall be of the same manufacturer as the switchgear, switchboard, MCC, and busway

3. The SPD shall be factory installed inside the switchgear, switchboard, MCC, and/or bus plug at the assembly point by the original equipment manufacturer

4. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.

5. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.

6. The SPD shall be integral to switchgear, switchboard, MCC, and/or bus plug as a factory standardized design.

7. All monitoring and diagnostic features shall be visible from the front of the equipment.

2.04 ENCLOSURES

A. All enclosed equipment mounted for indoor application shall be NEMA 1 general purpose enclosures. Provide NEMA 4X enclosures for all outdoor applications.

1. NEMA 1 – Constructed of a polymer (units integrated within electrical assemblies) or steel (sidemount units only), intended for indoor use to provide a degree of protection to personal access to hazardous parts and provide a degree of protection against the ingress of solid foreign objects (falling dirt).

2. NEMA 4X – Constructed of stainless steel intended for either indoor or outdoor use to provide a degree of protection against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (dirt and windblown dust); to provide a degree of protection with respect to the harmful effects on the equipment due to the ingress of water (rain, splashing water, and hose directed water).

2.05 POWER SUPPRESSORS FOR ELECTRONIC EQUIPMENT

A. Each item of electronic equipment provided under this contract and connected by line cord or direct wired to the building electrical system shall be provided with a three-stage single or multi-phase hybrid suppressor. Fusing shall be provided which removes the protective elements from the circuit upon failure. Visual indication or loss of output power shall be used to notify the user of device failure.

B. Suppressors shall be rated for a minimum of 125% of their continuous electrical load. Suppressors for cord connected equipment shall be equipped with standard NEMA cordsets one of which includes a molded grounding receptacle and the other, a molded grounding plug. Suppressor shall be installed in series with the power cord for the protected equipment. Where several items of equipment are grouped within the same cluster of equipment, one suppressor may be used in conjunction with properly sized grounding plugstrip to serve the equipment.

C. Suppressors for direct wired equipment shall be identical in internal design to the unit described for cord connected applications, however, protected screw terminals suitable for termination of solid copper wire shall be used for wiring terminations. One suppressor may be used to support several equipment cabinets provided all cabinets are located within the same equipment cluster and the maximum connected load shall not exceed eighty percent of the rated suppressor capacity.

D. Suppressors shall be constructed with a phenolic non-flammable exterior housing with provisions for mounting to the interior of equipment racks, cabinets, or to the exterior of free-standing equipment. Suppressors shall be constructed as three-stage devices. The first stage shall include a high-energy varistor clamp between line and neutral and from neutral to ground. The second stage shall consist of series air-core inductor installed in the line conductor(s) to properly coordinate the action of the first and third stages. The third, fast acting, hard clamping stage shall consist of a network of silicon avalanche bipolar surge suppression diodes between the neutral and line conductor(s).

E. Minimum suppressor performance characteristics shall be as follows:

1. Maximum single impulse line-to-neutral current withstand: 15,000 Amperes (8 x 20 us waveform)

2. Maximum single impulse neutral-to-ground current withstand: 10,000 Amperes (8 x 20 us waveform)

3. Pulse lifetime rating Category B worst case current waveform (8 x 20 us @ 3000 Amperes): 1200 occurrences

4. Pulse lifetime rating for 200 Ampere (8 x 20 us waveform): 10,000 occurrences

5. Worst case response time: Five Nanoseconds

6. Worst case (Maximum Single Impulse Current Conditions) clamping voltage: 400% of nominal phase-to-ground RMS voltage.

7. Initial breakdown voltage: 200% of nominal phase-to-ground RMS voltage.

2.06 SUPPRESSORS FOR CONDUCTOR PAIR PROTECTION

A. Suppression devices for conductor pair protection shall be provided in single-circuit pluggable packages suitable for the circuitry to be protected. Units for protection of data circuits which utilize standard connector configurations shall be equipped with connectors which install in series with the data cable to the protected equipment. Units intended for use with multiple wiring pairs shall be equipped with accessory terminal blocks or strips suitable for the type of wiring being used. Single pair units shall be configured as encapsulated units with wire leads or screw-terminal wiring terminations. Suppressors installed outside of terminal or equipment cabinets (except at designated terminal boards) shall be provided with a housing to afford physical protection for the surge suppression modules.

B. Suppression for each pair shall consist of a three-element gas tube first stage, an isolating element in series with each conductor of the pair, and a silicon avalanche second stage. Second stage clamping shall be provided across the pair for differential mode protection and from each side of the pair to ground for common mode protection. Resistive limiting elements may be used on low current circuits where the effect of voltage drop across the series resistance has no effect on circuit operation. Inductive series elements shall be used on higher current circuits to effectively pass direct or low frequency alternating currents while limiting passage of fast risetime surge waveforms. Silicon avalanche devices shall be designed for surge suppressor applications and shall be polarized or bipolar as appropriate for each circuit.

C. Minimum performance criteria (each circuit) shall be as follows:

1. Maximum single impulse conductor-to-ground or conductor to conductor current withstand: 10,000 Amperes (8 x 20 us waveform)

2. Pulse lifetime rating Category B worst case current waveform (8 x 20 us @ 3000 Amperes): 10 occurrences

3. Pulse lifetime rating for 100 Ampere (10 x 1000 us waveform): 1,000 occurrences

4. Worst case response time: Five Nanoseconds

5. Worst case (Maximum Single Impulse Current) clamping voltage: 200% of normal operating voltage amplitude and polarized or bipolar as appropriate for each circuit type.

6. Initial breakdown voltage: 150 percent of normal operating voltage peak amplitude plus or minus five percent.

7. Capacitance: Capacitance for DC or low frequency lines shall not exceed 2000 picofarads measured line to line or line to ground at the rated diode breakdown voltage. Suppressors intended for use on high frequency or high baud rate circuits shall be designed for use on such lines. Capacitance of such units shall be equated to equivalent cable feet based on the type of cabling used for the particular circuit. The sum of equivalent cable feet for suppressors and actual cable footage shall not exceed manufacturers recommended maximum values for the system on which these devices are installed.

8. Circuit compensation: Any additional circuit compensation (gain or equalization) required to compensate for the insertion of surge suppression devices shall be provided as part of this contract.

PART 3 -- EXECUTION

3.01 BONDING AND GROUNDING CONDUCTORS AND MATERIALS

A. Conductors utilized for surge suppressor bonding shall be a minimum of #6 AWG solid insulated copper unless otherwise specified.

B. Ground bus or strip material shall be copper, a minimum of 26 gauge in thickness and three inches wide unless otherwise specified. Bus materials may be secured to surfaces with an appropriate mastic material or mechanical fasteners. Bus connections shall be bolted or brazed and reinforced as necessary on thin bus material to provide a permanent and secure connection.

C. Unless otherwise specified, all surge suppression grounding electrodes shall be 5/8" diameter copperweld rods, twenty feet in length.

D. Connectors, splices, and other fittings used to interconnect grounding conductors, bond to equipment or ground bars, shall comply with requirements of the National Electric Code and be approved by Underwriters Laboratories for the purpose.

E. Connectors and fittings for grounding and bonding conductors shall be of the compression or set-screw type in above grade locations. Connections below grade shall be exothermically welded or brazed.

F. Bonding connections between electrically dissimilar metals shall be made using exothermic welds or using bi-metal connectors designed to prevent galvanic corrosion.

3.02 SEGREGATION OF WIRING

A. All system wiring shall be classified into protected and non-protected categories. Wiring on the exposed side of suppression devices shall be considered unprotected. Surge suppressor grounding and bonding conductors shall also fall into this category.

B. All wiring between surge suppressors and protected equipment shall be considered protected. Isolated circuitry exempted from surge suppression requirements in part one of this section shall also be considered protected.

C. A minimum of three inches of separation shall be provided between parallel runs of protected and unprotected wiring in control panels, terminal cabinets, terminal boards and other locations. In no case shall protected and unprotected wiring be bundled together or routed through the same conduit. Where bundles of protected and unprotected wiring cross, such crossings shall be made at right angles.

3.03 INSTALLATION OF SUPPRESSORS

A. Suppressors shall be installed as close as practical to the equipment to be protected consistent with available space. Where space permits and no code restrictions apply, suppressors may be installed within the same cabinet as the protected equipment. Suppressors installed in this manner shall utilize the equipment chassis as a medium for bonding of their ground terminals. Bonding jumpers not exceeding two inches in length shall be installed between the chassis and suppressor ground terminals. Bolted connections with star washers shall be used to insure electrical and mechanical integrity of connections to the equipment chassis.

B. Suppressors shall be installed in a neat, workmanlike manner. Lead dress shall be consistent with recommended industry practices for the system on which these devices are installed.

C. Bonding between ground terminals for power and signal line suppressors serving a particular item or cluster of equipment shall be kept as short as possible. Where practical, suppressors shall be installed in a common location for the cluster with their ground terminals bonded closely together. For installations requiring separation between the various suppressor grounds and equipment chassis within an equipment cluster, the following table shall be used to determine bonding conductor requirements (distances are measured between most distant suppressor or chassis grounds):

BONDING DISTANCE	MATERIAL
0 - 10 feet	#6 AWG Bare Copper (Solid)
10- 25 feet	1-1/2" Copper Strip 26ga. Min.
25- 50 feet	3" Copper Strip 26ga. Min.
Over 50 feet	6" Copper Strip 26ga. Min.

Care shall be exercised to avoid connection of incidental grounds to the bonding bus system.

D. Where terminal cabinets are used to house surge suppressors, painted steel backboards shall be used to serve as a low impedance ground plane for bonding surge suppressor leads together. Terminal boards used for the same purpose shall be laminated with a single sheet of 14 ga. galvanized steel to serve as a ground plane for suppressors. Suppressors with ground terminals not inherently bonded to the ground plane through their mounting shall be bonded to this plane using a two-inch maximum length of #12AWG copper wire and suitable lug. Ground planes and backboards shall be drilled to accept self tapping screws, any paint in the area of the bond shall be removed and star washers shall be used.

E. Supplementary grounding and bonding connections required between the bonding bus or ground plane for each equipment cluster and other locations as indicated herein shall be accomplished using #6 AWG bare copper conductors and approved connections unless otherwise noted.

3.04 WARRANTY

A. The manufacturer shall provide a full ten (10) year replacement warranty from the date of shipment against any SPD part failure in material or workmanship when installed in compliance with manufacturer's written instructions and any applicable national or local code.

-END OF SECTION-

SECTION 16910

CONTROL PANELS

PART 1 -- GENERAL

1.01 WORK INCLUDED

A. Furnish all labor, equipment, and materials for control panels as indicated on the drawings and specified herein. The panel supplier shall be a UL listed panel shop and all panels shall be UL-508 certified and labeled.

B. Control panel equipment shall be coordinated to provide all the specified control as indicate in the elementary diagrams or specified herein.

C. The Contractor shall be responsible for coordinating and interfacing with equipment and instrumentation supplied under other sections of the Contract Documents that are an integral part of the plant control systems. This interfacing shall be incorporated in the detailed systems drawings and data sections to be submitted by the contractor prior to rough-in work.

1.02 SUBMITTALS

A. The contractor shall submit to the Engineer for approval complete shop drawings, wiring diagrams, data, and operation and maintenance manuals of all equipment to be furnished under this section.

B. Coordination and Shop Drawings: Prepare and submit coordination drawings for installation of products and materials fabricated. Coordination and shop drawings shall be prepared using a computer aided drafting system compatible with Autodesk Autocad version 2014 or greater. Coordination and shop drawings shall be submitted on hard copy and electronic CD-Rom (dwg) format.

1. Submit component interconnect drawings showing the interconnecting wiring between each component including equipment supplied under other sections requiring interfacing with the control system. Diagrams shall show all component and panel terminal board identification numbers, and external wire and cable numbers. Note, this diagram shall include all intermediate terminations between field elements and panels (e.g., terminal junction boxes, pull boxes, etc.). Diagrams' device designations, and symbols shall be in accordance with NEMA ICS 1-101.

2. Panel Wiring Diagrams: Elementary diagrams shall be similar to those diagrams shown in the drawings, but with the addition of all auxiliary devices such as additional relays, alarms, fuses, lights, fans, heaters, etc.

3. Panel wiring diagrams shall identify wire numbers and types, terminal numbers, tag numbers and PLC I/O identification (address) numbers. Wiring diagrams shall show all circuits individually; no common diagrams shall be allowed.

4. Submit arrangement and construction drawings for consoles, control panels, and for other special enclosed assemblies for field installation. Include dimensions, identification of all components, preparation and finish data, nameplates, enough other details to define the style and overall appearance of the assembly and a finish treatment. Drawings shall show the location of all front panel mounted devices to scale, and shall include a panel legend and a bill of materials. The panel legend shall list and identify all front of panel devices by their assigned tag numbers, all nameplate inscriptions, service legends and annunciator inscriptions. The bill of materials shall list all devices mounted within the panel that are not listed in the panel legend, and shall include the tag number, description, manufacturer and complete model number for each device.

5. Submit installation, mounting, and anchoring details for all components.

C. Operation, Maintenance and Repair Manuals

1. Submit operation and maintenance manuals.

D. Panel Record Drawings

1. Provide one set of laminated approved panel record drawings inside each control panel.

2. Include one loose set of laminated approved panel record drawing inside of each control panel door data pocket.

1.03 CODES AND STANDARDS

A. Equipment, materials, and workmanship shall comply with the latest revisions of the following codes and standards

1. Instrumentation: Instrument Society of America (ISA).

2. National Electrical Code (NEC).

3. Wiring: ISA S5.3 and S5.4, latest issue.

4. Control Panels and equipment: NEMA, UL and ANSI.

5. Control Logic: Joint Industrial Council (JIC).

6. UL508A and UL508A-SB

PART 2 -- PRODUCTS

2.01 GENERAL

A. Control panels shall be UL508A/SB compliant. Control panels with resident voltages greater than 120V shall be marked with a short circuit current rating (SCCR). The SCCR shall be equal to or more than the short circuit current available at the panel line terminals and in no case be less than 10,000A SCCR. The panel designer shall verify the available short circuit required.

B. The electrical control equipment shall be mounted within a pad-lockable NEMA Type 4X wall mount for exterior installation locations and freestanding for interior installation locations, dead-front enclosure constructed of not less than 304 stainless steel powder coated white and shall be equipped with a 3-point latch with all hardware and exterior components construction of 300 series stainless steel (except control panels in air conditioned spaces and electrical room may be NEMA 1 painted steel). Provide data pocket. The enclosure shall be powder coated white. Bottom entry ONLY of cables shall be permitted. The enclosure shall be fitted with legs to allow conduit entry into the bottom of the enclosure. Flat bottom enclosures set on concrete pads with open window cutting of enclosure bottom for conduits is strictly prohibited. The enclosure shall be equipped with sunshields for exterior installation locations, an inner dead front door and shall incorporate a removable, aluminum or stainless steel back panel on which control components shall be mounted. Back panel shall be secured to enclosure with collar studs. Utilize stainless steel threaded standoffs welded to exterior of control panel to secure sunshields. All hardware shall be stainless steel. Provide safety hardware to hold the door in an open position.

C. Components: All motor branch circuit breakers; motor starters and DIN rail mounted control relays shall be of highest industrial quality, securely fastened to the removable back panels with screws and lock washers. Back panels shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any component.

D. A circuit breaker shall be provided on each control panel as a means of disconnecting power to the control panel. The circuit breaker operating handle shall be installed on the right side of the cabinet not in the door. The door shall be interlocked from opening when the circuit breaker is in the on position. Do not provide door interlock for lift stations. The circuit breaker operating handle shall have an interlock defeat mechanism for qualified personnel to gain access to the panel without shutting off power.

E. Control transformers shall be installed where shown to provide 120VAC and 24VAC for control circuits. Transformers shall be fused on the primary and secondary circuits. The transformer secondary shall be grounded on one leg.

F. All control panel wiring shall be identified at both ends with type written heat shrinkable wire markers with the numbering system shown on the control submittal drawings.

1. Control wiring shall be stranded tinned copper, minimum size #16 AWG (except for shielded instrumentation cable may be #18 AWG), with 600 volt, 90 degree C, flame retardant, Type MTW thermoplastic insulation.

2. Wire shall be guided within control and terminal cabinets by cable supports (duct). Instrumentation and control field cables on the unprotected side of SPD devices within the cabinet shall not run in parallel to the cables on the protected side of the SPD device. Separate cable supports (duct) will be provided.

3. All conductors shall be neatly led to terminations. All connections of stranded wire to screw type terminal blocks shall be by insulated spade lugs, crimp fastened to wire. Provide stranded wire crimp ferrules for all stranded wire connections not requiring spade lugs for screw type terminal blocks.

G. The control panel shall be provided with nameplates identifying each component, selector switches, pilot lights, etc. Nameplates shall be permanently affixed using an epoxy process. Nameplates shall be laminated plastic, engraved white letters with a black background. List the manufacturer of the control panel cabinet and the control panel builder.

H. Corrosion Inhibitor Emitter: Provide an industrial corrosion inhibitor emitter on all exterior mounted control panels that will protect internal components of the control panel from corrosion one year. Provide a year supply of spare emitters, for each control panel.

I. Terminal strips shall be provided for all signals as indicated on the drawings plus all spare conductors as specified. Terminal strips shall be switch type with integral fuses equal to Allen Bradley 1492-H6. Wiring from the control panel to the terminal strips shall be factory installed. All spare conductors shall be terminated and identified. All terminals over 200V phase to phase shall be covered with approved plastic shields.

J. RELAYS

1. Control circuit switching shall be accomplished with relays. These relays, for interfacing and control applications, shall be the compact general purpose plug-in type having low coil inrush and holding current characteristics. An LED status-indicating light shall be provided with each relay. Contact arrangements shall be as noted or shown, and shall be rated for not less than 10 amperes at 120V ac or 28V dc. Coil voltage shall be as noted or shown. Non-latching relays shall have a single coil. Latching relays shall have two coils, unlatching being accomplished by energizing one coil, and latching being accomplished by energizing the other coil. Relays shall have plain plastic dust covers, test buttons, and mounting sockets with screw terminals and holddown springs. Relays shall be UL recognized. Relays shall be Square D, Allen Bradley, Omron or approved equal.

2. Time on delay functions shall be accomplished with Square-D 9050JCK60V20 timer relays. Provide RK electronics CFB24D-7-2M relay for time off delay applications. Units shall be adjustable time delay relays with the number of contacts and contact arrangements as shown. A neon status-indicating light shall be provided with each relay. Contacts shall be rated for 10 amperes at 120V ac. Integral knob with calibrated scale shall be provided for adjustment of time delay. Initial setting shall be as shown with time delay range approximately three times the initial setting. Time delay rangeability shall be at least 10:1. Operating voltage shall be 120V ac, plus 10 percent, -15 percent at 60-Hz. Operating temperature shall be -20 degrees F to 165 degrees F. Repeat timing accuracy shall be plus or minus 10 percent over the operating range. Units shall be Amerace Corp., Control Products Division, Agastat Series 7000, Cutler-Hammer Series D87, Square D, Allen Bradley, Omron or approved equal.

3. All relays shall have a screw terminal interface with the wiring. Terminals shall have a permanent, legible identification. Relays shall be mounted such that the terminal identifications are clearly visible and the terminals are readily accessible.

K. Panel Operating Controls and Instruments

1. All operating controls and instruments shall be securely mounted on the interior deadfront as detailed on panel enclosure drawings. All controls and instruments shall be clearly labeled to indicate function.

2. Indicator lamps shall be 30mm LED full voltage push to test type and mounted in NEMA 4X (800H) modules, as manufactured by Allen Bradley or SKPI as manufactured by Square D. Lamp modules shall be equipped to operate at 24 or 120 volt input. Lamps shall be easily replaceable from the front of the control compartment door without removing lamp module from its mounted position. Units shall be heavy-duty, oiltight, push to test industrial type with screwed on prismatic glass lenses in colors as shown, and shall have factory engraved legend plates. LED's shall be high illumination type (5ma at 130V ac).

3. Selector switches shall be 30mm heavy-duty, oiltight, industrial type selector switches with contacts rated for 120V ac service at 10 amperes continuous. Units shall have standard size, black field, legend plates with white markings, as indicated. Operators shall be black knob type. Units shall have the number of positions and contact arrangements and spring return function (if any) as shown. Units shall be single-hole mounting, accommodating panel thickness from 1/16-inch minimum to 1/4-inch maximum. Units with up to four selection positions shall be Allen Bradley 800H, Square D Type K, Cutler-Hammer Type T, or equal.

4. 22mm devices are not acceptable.

L. Process Meters

1. Provide digital programmable process meters with a loop powered display designed for a 4-20MA current loop. Provide minimum 0.5" high, 4-1/2” digit LED display to indicate amplitude of current in the current loop. In general, a loop current of 4ma corresponds to a display indication of 0 percent and a loop current of 20ma corresponds to a display indication of 100 percent. The meter shall be provided with programmable internal scaling adjustment. Provide units with NEMA-4X faceplate rating constructed of silicone coated Lexan and gasketed for NEMA 4 requirements; circuit boards coated for moisture resistance. Provide panel meters for each analog process variable; Pressure, level and flow as indicated equal to Yokogawa, Red Lion, or equal.

M. Phase Monitors

1. Provide ATC Diversified and or Macromatic.

N. Uninterruptable Power Supply (UPS)

1. Provide 24VDC input, 12/24VDC dual output UPS. Puls UB10.241 UPS, no equal.

PART 3 -- EXECUTION

3.01 MOUNTING OF EQUIPMENT AND ACCESSORIES

A. Install and mount equipment in accordance with the Contract Documents, and installation detailed shop drawings. Mount equipment so that they are rigidly supported, level and plumb, and in such a manner as to provide accessibility; protection from damage; isolation from heat, shock and vibration; and freedom from interference with other equipment, piping, and electrical work.

B. Mount local equipment in cabinets or existing panels as specified. Mount associated terminals on a common panel or rack; all terminals over 200V phase to phase shall be covered with plastic shields.

C. Provide services of panel manufacturer to test the completed system after installation to assure that all components are operating within the specified range and all interlocks are functioning properly. Panel manufacturer shall certify functional operation and calibration in written startup report. Perform field tests on all completed control assemblies to demonstrate conformance to specifications and functional compatibility.

-END OF SECTION-

DIVISION 17

Instrumentation

SECTION 17000

INSTRUMENTS AND CONTROL PROGRAMMING REQUIREMENTS

PART 1 -- GENERAL

1.01 SCOPE

A. The INSTRUMENTATION SUBCONTRACTOR shall provide all programming as defined herein and shall supply the new field instruments as listed herein and noted on the Drawings.

B. Programming shall be performed using the standards set by the Lee County Utilities.

C. The scope of the work to be performed under this Section includes, as a minimum:

1. The CONTRACTOR shall retain overall responsibility for the modifications to the plant instrumentation and control system as specified herein.

2. The CONTRACTOR shall be responsible to install all new instruments as specified herein and as indicated on the Drawings.

3. The CONTRACTOR shall furnish and install new instrument supports, sunshield, and mounting hardware as shown on the Drawings.

4. The ELECTRICAL SUBCONTRACTOR shall provide final termination and testing of all instrumentation and control system signal wiring and power supply wiring at all equipment furnished under this Section.

5. The INSTRUMENTATION SUBCONTRACTOR shall furnish the field instruments as specified herein to be installed by the CONTRACTOR and wired by the ELECTRICAL SUBCONTRACTOR.

6. The INSTRUMENTATION SUBCONTRACTOR shall furnish and fully program the new hypochlorite PLC panel as specified herein to be installed by the CONTRACTOR and wired by the ELECTRICAL SUBCONTRACTOR.

7. The INSTRUMENTATION SUBCONTRACTOR shall furnish and install transient voltage surge suppression systems for all new analog instruments.

8. The INSTRUMENTATION SUBCONTRACTOR shall provide testing, calibration, training and startup services as specified herein.

9. The INSTRUMENTATION SUBCONTRACTOR shall provide the new fiber optic cable, and terminations on both ends after installation by the ELECTRICAL SUBCONTRACTOR, to allow full communications between the new centrifuge PLC (supplied under Division 11), the new hypochlorite feed system PLC (supplied under this Section) and the plant SCADA system.

10. The INSTRUMENTATION SUBCONTRACTOR shall provide the necessary programming changes on the facility's existing plant SCADA workstation operator interface software as described herein to fully incorporate the new instruments and equipment installed under this project.

1.02 ANALOG SIGNAL TRANSMISSION

A. Signal transmission between electric or electronic instruments, controllers, and all equipment and control devices shall be linear 4-20 milliamperes and shall operate at 24 volts D.C. Signal isolation and/or conversion shall be provided where necessary to interface with instrumentation, equipment controls, panels and appurtenances.

B. Signal output from all transmitters and controllers shall be current regulated and shall not be affected by changes in load resistance within the unit's rating.

C. All cable shields shall be grounded at one end only, at the control panel, with terminals bonded to the panel ground bus.

1.03 DISCRETE INPUTS

A. All discrete inputs from field devices shall be dry contacts in the field device or equipment, powered from the signal source with isolation to the PLC inputs.

B. Sensing power (wetting voltage) shall be 120V AC.

1.04 DISCRETE OUTPUTS

A. All discrete outputs to field devices shall be through isolation relays in the source control panel with coil voltage rated for 24 VDC powered (sourced) from the PLC. Contacts on the relays are to be rated for up to 120V AC power and be as required for interfacing device.

1.05 INSTRUMENT AND HARDWARE SUBMITTALS

A. Submit information for all new hardware including, but not limited to, the following:

1. Product (item) name and tag number.

2. Catalog cuts.

3. Manufacturer's complete model number.

4. Location of the device.

5. Input - output characteristics.

6. Range, size, and graduations.

7. Physical size with dimensions, NEMA enclosure classification and mounting details.

8. Materials of construction of all enclosures, wetted parts and major components.

9. Instrument or control device sizing calculations where applicable.

10. Certified calibration data on all flow metering devices.

11. Environmental requirements during storage and operation.

12. Associated surge protection devices.

13. Mounting requirements.

14. Environmental requirements during storage and operation.

15. Complete panel fabrication shop drawings including panel layouts and wiring diagrams.

1.06 SOFTWARE SUBMITTALS

A. Software submittals shall include the following as a minimum:

1. PLC input/output schedules for interface with values being sent to and received from the existing plant PLC for new field I/O and internal data registers. List complete addresses and tagnames for each new register.

2. Existing plant workstation operator interface software (OIS) new database points including OIS tagname, corresponding PLC register cross reference, scales, functions, etc.

3. Written control strategy documentation to describe the proposed control logic interface with the new signals logic.

4. Upon approval of PLC input/output schedules, new OIS database point list, and written control strategy documentation, submit a complete hard copy of fully commented PLC ladder logic programming and a complete hard copy of proposed OIS display screen modifications.

1.07 OPERATION AND MAINTENANCE MANUALS

A. Provide equipment operation and maintenance manuals for new instruments. The manuals shall contain all illustrations, detailed drawings, wiring diagrams, and instructions necessary for installing, operating, and maintaining the equipment. The illustrated parts shall be numbered for identification. All modifications to manufacturer standard equipment and/or components shall be clearly identified and shown on the drawings and schematics. All information contained therein shall apply specifically to the equipment furnished and shall only include instructions that are applicable. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book.

B. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel unfamiliar with such equipment. The maintenance instructions shall include trouble shooting data and full preventive maintenance schedules. The instructions shall be bound in locking 3-D-ring binders with bindings no larger than 3.5 inches and

searchable PDF files of the material shall be provided on electronic media. The manuals shall include 15% spare space for the addition of future material. The instructions shall include Drawings reduced or folded and shall provide at least the following as a minimum.

1.08 FINAL SYSTEM DOCUMENTATION

A. Provide two copies on electronic media for all software modifications for the new PLC and existing OIS system revisions. PLC files shall include all comments. Provide panel fabrication drawings and wiring diagrams in dwg and pdf format on electronic media.

1.09 SHIPPING HANDLING AND STORAGE

A. In addition to shipping, handling and storage requirements specified elsewhere in the Contract Documents, air conditioning/heating shall be provided for storage of all new field instrumentation and ancillary devices to maintain temperatures between 20 and 25 degrees C and relative humidity 40 to 60 percent without condensation. The air shall be filtered and free of corrosive contaminants and moisture.

1.10 INSTALLATION

A. All instrumentation and control system installation work shall conform to all applicable codes and standards and be in accordance with manufacturer's recommendations.

B. All labor shall be performed by qualified craftsmen in accordance with the standards of workmanship in their profession and shall have had a minimum of five years of documented experience on similar projects.

D. All equipment and materials shall fit properly in their installations. Any required work to correct improperly fit installations shall be performed at no additional expense to the City.

E. The CONTRACTOR shall provide all required cutting, drilling, inserts, supports, bolts, and anchors, and shall securely attach all equipment and materials to their supports.

1.11 OPERATOR TRAINING

A. Provide a minimum of two sessions, each approximately 2 hours in duration, to train operations staff on the new controls.

1.12 CONTROL SYSTEM SUPPLIER

A. The INSTRUMENTATION SUBCONTRACTOR's scope of work may be performed by any qualified instrumentation subcontractor experienced with municipal domestic wastewater treatment plant control system work as long as the proposed instrumentation subcontractor can meet the requirements of the County's Control, Telemetry, Security and SCADA Integration Services Continuing Contract RFQ (as listed at the end of this section) and the proposed instrumentation subcontractor has sufficient experienced personnel for the type of work proposed, particularly the programming of the new PLC and the existing plant SCADA system revisions required.

B. The existing plant SCADA system human machine interface (HMI) software is Citect. The INSTRUMENTATION SUBCONTRACTOR shall be a qualified system integrator to

implement the needed modifications to the Citect displays and database to monitor and control the replacement hypochlorite feed system and full depict and allow full monitoring and remote interface with the new dewatering system equipment. SCADA interface shall follow standard County practices for Citect development and shall provide full interface with the new equipment as specified herein.

C. The INSTRUMENTATION SUBCONTRACTOR shall be able to offer personnel that have at least five year's experience in the programming of the type of PLC supplied under this project and at least three projects completed in the last 10 years using Citect HMI software.

PART 2 -- PRODUCTS

2.01 HYPOCHLORITE CONTROL PANEL

A. Provide a new control panel for the hypochlorite storage and feed system. Control panel shall be designed for 120 volt, single phase service and provide power to the feed pumps and the field instruments associated with the process.

B. The panel shall be a rack-mounted panel, constructed in accordance with UL 508 requirements for enclosed industrial control panels and shall bear the serialized UL label. Enclosure shall include the following:

1. The Control Panel shall be formed or welded construction, reinforced with stainless steel members to facilitate mounting of internal components or equipment. Door shall be of sufficient opening size to facilitate maintenance and testing of the internal components. Panels shall be provided with a means to facilitate safe moving and lifting of the panel during installation.

2. Panel enclosure shall be all Type 316 stainless steel, minimum 12 USS gauge, fully enclosed NEMA 4X with gasketed doors. The panel exterior shall be coated with a phosphatized baked enamel white coating.

3. The enclosure shall have a 12-ga steel, formed, removable subpanel. The subpanel shall be degreased, cleaned, treated with a phosphatizing process, then primed and painted with white industrial grade baked enamel

4. All conduits extending outside of the panel shall be sealed to prohibit condensation and vapor entry into the panel.

5. Panel door shall be designed for front access and fitted with lockable, three-point door latches that maintain the NEMA4X rating when fully engaged.

6. Panel shall be provided with a folding laptop programmer shelf on the inside of the door and a metal print pocket for the control panel as-built drawings.

7. Panel enclosure shall be a prefabricated panel by Hoffman or approved equal.

C. The panel shall consist of the following components:

1. Branch Circuit Breakers: Circuit breakers shall be quick-make, quick-brake and trip free. The thermal and magnetic elements shall operate independently and be designed with a common trip bar breaking all poles when a fault is received on any pole. The circuit breakers shall be as manufactured by Square D for 120V (QOU1 series) and 460V (HGL36 series) service. Provide breakers for the main panel 120V feed, the panel receptacle and light, the panel air-conditioner, the UPS power feed, and branch circuit breakers on the UPS power to each PLC module.

2. Uninterrupted Power Supply (UPS): The PLC shall operate on 120V power from a UPS securely mounted inside the panel (loose installation at bottom of panel not acceptable). The UPS shall be Best, APC, or approved equal with outputs to the PLC to indicate battery life low, running on battery status, UPS fault. UPS shall be sized, and panel shall be wired, to power all PLC components, telemetry communications equipment, and station control functions within the panel. Panel ventilation shall be sized to dissipate the heat generated by the UPS when running on battery, full load.

3. Surge Suppression: Provide a surge arrestor installed on the line side of the main breaker in accordance with manufacturer's instructions. Provide surge suppression devices on all signal and power leads on all circuits that have any part of the control or power circuit that extends past the limits of the hypochlorite structure and on all analog signals into or out of the panel. Surge devices shall match the components used by the County throughout the WRF facility.

4. Programmable Controller (PLC): The PLC shall be Allen-Bradley CompactLogix Catalog No. 1769-L series controlloers using Rockwell Automation RSLogix 5000 Professional Edition software to match PLC components and software versions supplied under Division 17. Provide I/O modules Catalog No. 1769-IQ16 24Vdc discrete input modules, Catalog No. 1769-OB16 24Vdc discrete output modules, Catalog No. 1769-IF8 4-20mA analog input modules (with Allen Bradley or Phoenix Contact Hart enabled isolators), and Catalog No. 1769-OF8C 4-20mA analog output modules. Power supplies shall be Allen Bradley 1769-PA series. PLC hardware and software shall be provided to allow operators to make changes to setpoints and control settings within the PLC over the plant SCADA network. Software ladder programming shall be set up to allow modifications to the programming either through direct laptop connection at the PLC or over the telemetry link. Provide input/output modules in sufficient quantities specified herein and as required to meet functional requirements of the Specification. PLC hardware and power supplies shall be provided with all necessary cabling, mounting hardware, racks and connectors for a fully functional system. I/O teriminal strips shall be removable without disturbing field wiring. Provide a minimum of 10% spare slot capacity in the card rack for future expansion and 15% spare I/O capacity for each type of input (rounded up to the next whole number of required points or channels). Provide 25% spare memory on the PLC CPU after the PLC has been programmed for full operation.

5. Operator Interface: Operator Interface Unit (OIU) shall be an Allen Bradley Panelview Plus 10-inch, TFT color display and shall be programmed to allow full and complete control and monitoring of the hypochlorite system. Operator input is to be available

through touch screen interface. Operator Interface shall be 24Vdc powered, mounted on the panel front door.

6. Fiber Optic Interface: The panel PLC shall communicate with the plant PLC network directly over a fiber optic link. PLC Fiber Optic module, fiber cable, and fiber conduit shall match existing fiber optic network equipment using Sixnet Media Converters. Fiber optic cable connections shall match existing cable connection type.

7. Panel Air Conditioner: The panel shall be fitted with a side-mounted air-conditioning unit to maintain internal panel temperatures below 95°F, and shall be McLean Panel A/C units. Cooling shall be closed loop to separate sealed internal panel air from outside air to maintain the panel NEMA 4X rating. The unit shall be of stainless steel construction with exterior shields and special coatings applied to coils and copper lines exposed to ambient air to protect the unit from corrosive ambient conditions. Units shall operate on 120V ac power. Thermostat shall be mounted inside the panel.

8. As-built Drawings: A laminated “As Built” copy of the panel wiring diagrams shall be provided and placed in the panel print pocket for all panels that include PLCs. All panel drawings shall be developed using AutoCad®. The drawings shall have a complete Bill of Materials, panel exterior and interior layouts, and show all electrical wiring. As-built drawings shall be submitted with the O&M materials on electronic media in both AutoCad® (.dwg) and Adobe Acrobat® (.pdf).

9. Terminals: Terminal blocks shall be as follows:

    a. Terminal blocks shall be assembled on non-current carrying galvanized steel DIN mounting rails securely bolted to the cabinet subpanel. Terminals shall be of the screw down pressure plate type as manufactured by Allen Bradley or Phoenix Contact.

    b. Power terminal blocks for both 120 VAC and 24 VDC power shall be single tier with a minimum rating of 600 volts, 30 amps.

    c. Discrete signal terminal blocks shall be 2-tier with a minimum rating of 600 volts, 20 amps. One terminal block shall be used for each signal. The positive wire shall be installed on the top or left-most terminal.

    d. Analog signal terminal blocks shall be 3-tier with a minimum rating of 600 volts, 20 amps. One terminal block shall be used for each signal. The positive wire shall be installed on the top or left-most terminal and the shield/drain wire shall be installed on the bottom or right-most terminal.

    e. Only one wire shall be terminated under a single wire clamp or screw.

    f. Terminal blocks for field wire connections shall be added as needed in 10-pole increments. Terminal blocks shall be mounted with a minimum of 2” from both enclosure sides and from the bottom of the enclosure for easy access to terminal screws.

    g. Terminals shall be marked with a permanent, continuous marking strip. One side of each terminal shall be reserved exclusively for field incoming conductors.

Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal.

h. Separate terminal strips shall be provided for each type of power and signal used within each cabinet. Where applicable, terminal strips for different voltages of discrete signal wiring shall also be separated. Terminal strips shall be labeled as to voltage and function.

10. Wiring: All wiring shall be color-coded using tinned copper MTW #14 AWG minimum for power and control wiring and #16 twisted pair for analog signal wiring. Wiring and cables shall be numbered at each end. Wire numbers shall be printed on non-removable heat-shrink tags. Wires shall be color coded as follows:

    Equipment Ground - GREEN

    120 VAC Power - BLACK
    120 VAC Power Neutral - WHITE

    120 VAC Control (Internally Powered) - RED
    120 VAC Control (Externally Powered) - YELLOW

    24 VAC Control - ORANGE

    DC Power (+) - BLUE
    DC Power (-) - GRAY

    Analog Signal – BLACK/WHITE

11. Component Labels: All interior panel components shall be individually labeled on the back plate with a custom engraved plastic tag with adhesive back. The tags shall be white with black letters and match the nomenclature indicated on the as-built wiring diagrams.

12. Mounting Hardware: All mounting hardware such as screws or bolts used in the manufacturing of the control panel shall be Type 316 stainless steel. All holes in the back plate and dead front shall be drilled and tapped. No self-tapping screws, adhesive tapes, or Velcro will be accepted for the mounting of any hardware.

13. Interposing relays shall be provided on all discrete outputs on the PLC and shall be DIN rail mounting type, DPDT, minimum 10 amp, 120 VAC contact rating. Relay coils shall be 120 VAC or 24 VDC as required. Relays shall have a flag indicator to show relay status, a pushbutton to allow manual operation of the relay, and an internal pilot light to indicate power to the coil. Relays shall be as manufactured by Phoenix Contact or Allen Bradley.

14. Timing Relays shall be provided for any direct wired equipment protection circuits to prevent nuisance tripping. Timing relays shall be the general purpose DIN rail mounting type, as manufactured by Phoenix Contact. Timing relays shall be electronic type with 120 VAC coils unless otherwise specified or indicated on the Drawings. Timers shall be provided with a minimum of two SPDT timed output

contacts and instantaneous contacts where required. Contact ratings shall be the same as for interposing relays as specified above.

15. Corrosion Protection: Panel interior components shall be treated with a corrosion inhibiting spray on all exposed metallic surfaces, particularly terminations, contacts, and wire ends. After installation, furnish corrosion inhibiting capsules that emit molecular level coating on metallic surfaces throughout the panel that provide specific corrosion barrier toward hydrogen sulfide and/or subsequent formation of sulfuric acid when combined with ambient moisture.

16. Panel Seal-Offs: All conduits entering the panel shall be sealed at the conduit entry point with a removable, expandable conduit seal material to prohibit outside air from entering the panel.

17. Selector switches shall be heavy-duty, oil-tight type with gloved-hand or wing-lever operators. Position legends shall be engraved on the switch legend plate. Switches for electric circuits shall have silver butting or sliding contacts, rated 10A continuous at 120 VAC. Contact configuration shall be as indicated on the Drawings, or as required for the application. Switches used in electronic signal circuits shall be contacts suitable for that service duty. Switches shall be Cutler-Hammer “Type 34”, Micro-Switch equivalent, General Electric equivalent, or Square D Type SK (NUK). The Centrifuge Manufacturer shall supply a minimum of two (2) spare contact blocks on both hand and auto positions of selector switches for every switch on the CCP.

18. Indicating lights shall be heavy-duty, oil-tight type. Legends shall be engraved on the legend plate. Lamps shall be easily replaceable from the indicating light. Indicating lights shall be Square D Type SK, A/B Type 800H, IDEC, or pre-approved equal.

19. Pushbuttons shall be heavy-duty, oil-tight type. Legends shall be engraved on the legend plate. Contacts shall be rated 10A continuous at 120 VAC. Pushbuttons shall be Square D Type SK, A/B Type 800H, IDEC, or pre-approved equal.

D. Programming: See Paragraph 2.06.

2.02 SLUDGE FEED MAGNETIC FLOW METER

A. Magnetic flow meter system shall include a magnetic flow tube and a microprocessor based "smart" transmitter that is capable of converting and transmitting a signal from the flow tube. The magnetic flow meters shall utilize the characterized field principle of electromagnetic induction, and shall produce DC signals directly proportional to the liquid flow rate.

B. Each meter shall be furnished with a stainless steel metering tube and carbon steel flanges with a Polyurethane liner as required by the application and/or as specified herein. Liner shall have a minimum thickness of 0.125 inches. The inside diameter of the liner shall be within 0.125 inches of the inside diameter of the adjoining pipe. Liner protectors shall be provided on all flow tubes.

C. The flow tube shall be provided with flush mounted, field removable electrodes. Automatic electrode cleaning systems shall not be acceptable.

D. Grounding rings shall be provided for all meters and specific ground instructions shall be given to the electrical subcontractor connecting the meter and all such instructions shall be adhered to by the Contractor.

E. All materials of construction for metallic wetted parts (electrodes, grounding rings, etc.) shall be minimum 316 stainless steel or Hastelloy C, but shall be compatible with the process fluid for each meter in accordance with the recommendations of the manufacturer.

F. Flow tube shall be rated for temperatures of up to 180 degrees Celsius and pressures up to 1.1 times the flange rating of adjacent piping. System shall be rated for ambient temperatures of -30 to +65 degrees Celsius. Meter and transmitter housings shall meet NEMA 4X requirements as a minimum. When meter and transmitter are located in classified explosion hazard areas, the meter and transmitter housings shall be selected with rating to meet the requirements for use in those areas.

G. The transmitter shall provide pulsed DC coil drive current to the flow tube and shall convert the returning signal to a linear, isolated 4-20 mA DC signal. The transmitter shall utilize "smart" electronics and shall contain automatic, continuous zero correction, signal processing routines for noise rejection, and an integral LCD readout capable of displaying flow rate and totalized flow. The transmitter shall continuously run self diagnostic routines and report errors via English language messages.

H. The transmitter's preamplifier input impedance shall be a minimum of 10^{9}-10^{11} ohms which shall make the system suited for the amplification of low-level input signals and capable of operation with a material build up on the electrodes.

I. The transmitter shall provide an automatic low flow cutoff below a user configurable low flow condition (0-10%). The transmitter's outputs shall also be capable of being forced to zero by an external unpowered signal.

J. The transmitter shall be capable of communicating digitally with the system process control RTU/PLC via Ethernet IP link suitable for transmitting all flow meter data, including flow rate, flow totalization, alarm status, diagnostics, etc. Provide sufficient Ethernet cable to connect directly with the RTU or fiber optic conversion panel as noted on the Drawings.

K. Accuracy shall be 0.5% of rate over the flow velocity range of 0.3 to 10.0 m/s. Repeatability shall be 0.1% of rate; minimum rangeability shall be 100:1. Minimum required liquid conductivity shall not be greater than 5 uS/cm. Maximum response time shall be adjustable between 1 and 100 seconds as a minimum. Transmitter ambient temperature operating limits shall be -10 to +50 degrees Celsius. Power supply shall be 115 VAC, 60 Hz.

L. Each flow tube shall be factory calibrated and assigned a calibration constant or factor to be entered into the associated calibration constant or factor to be entered into the associated transmitter as part of the meter configuration parameters. Manual calibration of the flow meter shall not be required. Meter configuration parameters shall be stored in non-volatile memory in the transmitter. An output hold feature shall be provided to maintain a constant output during configuration changes.

M. Flow tubes shall be 150 lb flange mounted unless otherwise noted. The cables for interconnecting the meter and transmitter shall be furnished by the manufacturer. Transmitter shall be mounted on the wall or 2-inch instrument stand as shown in the Drawings and/or as specified.

N. The flow transmitter shall have a current linear output of 4-20mA.

O. Magnetic flow meter systems shall be manufactured by Endress & Hauser, Promag L meter and Promag 53 transmitter, or approved equal.

Magnetic Flow Meters			
Service Description	**Range**	**Line Size**	**Comments**
Sludge Feed	0-500 gpm	6”	Low flow cutoff set at 10 gpm (~0.1 fps)

2.03 TRUCK LOADING LEVEL TRANSMITTERS

A. Each ultrasonic level monitoring system shall include one ultrasonic level sensor and an integral "intelligent" transmitter. Provide five ultrasonic level monitoring systems to monitor the level of material deposited in the receiving truck bed. Units shall be mounted to and beneath the truck loading conveyor with displays viewable from the conveyor catwalk. Mounting of the level transmitters shall be coordinated with mounting devices provided with the conveyor supplied under Division 14. Each ultrasonic level monitoring system shall be required to monitor the level of cake solids in the associated area of the loading truck bed.

B. Provide approved watertight conduit hub/glands to maintain complete watertight assembly. Transmitter/transducer assembly shall be suitable for mounting to the tank’s existing 4” nozzle, constructed of corrosion resistant materials.

C. The level sensor shall be unaffected by moisture droplets on the transducer face and operate on the ultrasonic echo ranging principle. The sensor shall also be fully submersible and resistant to corrosive materials. Sensor accuracy shall be a minimum of 0.25 percent of level measurement range, and include integral temperature compensation with an accuracy of 0.09% of range. Resolution shall be at least 0.1 percent of full range or 0.08 inches, whichever is greater.

D. The transmitter shall be programmable by using a hand-held programmer. Display shall be LCD with backlighting, shall have the capability to display a minimum of 4 characters at one time, and shall be shielded from direct sunlight. The units shall have as a minimum, the required number of programmable set points to perform the functions specified. Each set point shall operate a set of contacts rated at 5 amps, 250 VAC, non-inductive.

E. The transmitter shall compensate for changes in temperature and air density. The transmitter shall generate an output level signal that is a linear, isolated 4-20 mA DC, with sufficient energy to drive the signal and the local level indicator provided. Display on the unit shall be shown in feet from bottom of the level sensor to the irregular or sloped surface of the material deposited in the truck bed. Devices shall compensate for non-level solids material deposition. Power requirement for the transmitter shall be loop powered requiring no external power feed other than the 4-20mA signal loop. The units shall have a NEMA 4X stainless steel or nonmetallic enclosure.

F. Ultrasonic level measurement systems shall be Endress & Hauser FMU42 or equivalent unit as manufactured by Seimens.

2.04 HYPOCHLORITE TANK AND LIFT STATION LEVEL TRANSMITTERS

A. Provide a liquid level measurement system for each of two hypochlorite tanks and a replacement level transmitter for the existing lift station. Each device shall be a 2-wire 26 GHz pulse radar microwave radar level measurement system. The device shall use advanced signal processing with *Process Intelligence*^{R} including auto-false-echo-suppression.

B. The controller shall provide one 4-20 mA DC output signal with superimposed HART proportional to material level or Profibus-PA communications. Profibus-PA protocol shall be Profile version 3.01, Class B

C. Programming shall be accomplished via an optical keypad without the need to open the enclosure for programming thus maintaining the NEMA 4X integrity of the enclosure. There shall be no internal potentiometers or switches used in programming the controller

D. The indicator display shall be alphanumeric and multi-graphic liquid crystal for measurement readings and operational status. Signal profile shall be available for view in indicator display.

E. The controller shall have an EEPROM memory and shall not require a battery to ensure protection of entered parameters and operational data.

F. This unit shall have a minimum range of 2” (0.05 m) as measured from the end of the horn with a maximum range to 65’ (20 m) as measured from the bottom of the connection flange or the threaded NPT. Provide connection to, and nozzle of bulk head fitting for, mounting to the chemical tank for each application.

G. There shall be a choice of 4 horn antenna sizes of 1-1/2”, 2”, 3”, or 4”.

H. The design shall have process connections of either a 1-1/2” with the 1-1/2” horn antenna or 2” NPT thread with 2” horn antenna or the design is available with ANSI or DIN Flanges from 2” 150 or 300 lb. RF.

I. The equipment shall be as manufacturered by Vega, Vegapuls series, or Siemens model SITRANS LR 250 Microwave Radar.

J. Provide local level indicators to provide local level indication in feet for both storage tanks based on the level signal from the new level transmitters. Indicators are to be housed in a new, NEMA 4X, Type 316 stainless steel enclosure of adequate size to house the two indicators, mounted on a rack adjacent to the tank fill station, and be utilized as a pull box for retransmission of the level signals to the PLC as indicated on the drawings. Enclosure shall be a standard fabricated enclosure as supplied by Hoffman, or equal. Indicators shall be located beneath a fabricated stainless steel sunshield provided with the enclosure to allow viewing of the display while keeping the display out of exposure to direct sunlight.

K. Electronic indicators shall be 3.5 digit indicators, with 0.48" high, reflective LCD display. Indicators shall be provided with plastic nameplate, white with black letters, to identify the tank and units displayed. Indicator scale shall match the calibration of the level signal input. The unit shall be designed primarily for use with 4-20 mA current loop signal circuits and

powered through loop power. Indicators shall be suitable for outdoor service (high brightness) and be NEMA 4X rated. Indicators shall be Red Lion Model CUB4, or equal.

2.05 PRESSURE GAUGES

A. Provide one gage for each new sludge feed pump suction and discharge line. All gauges shall be designed in accordance with the ASME B40.1 entitled, "Gauges, Pressure, Indicating Dial Type - Elastic Element".

B. All gauges shall be direct reading type. Snubbers and resettable maximum reading pointers shall be provided. Gauge full scale pressure range shall be selected such that the maximum operating pressure shall not exceed the approximately 75% of the full scale range.

C. Features
   1. Mounting: 1/2-inch NPT, lower stem mount type
   2. Accuracy: ±2% full scale
   3. Case: Solid front, black phenolic material, process pumps
      Stainless steel, smaller lines
   4. Dial: 4-1/2 inch dia. dial size, white background, black letters
   5 Glass: Shatterproof
   6. Blow-out protection: Back
   7. Pressure element: stainless steel bourdon tube
   8. Movement: Stainless steel, Teflon coated pinion gear and segment
   9. Gaskets: Buna-N

D. Gauges shall be liquid filled. Silicone oil filling fluid shall be suitable for ambient temperature ranging from -10^0F to $+150^o$F. Seals shall be oil filled, all 316 stainless steel construction with diaphragms of 316L stainless steel unless a more suitable material of equal corrosion resistance is recommended for lower operating pressures. Seals shall have 1/2” instrument connection upper housing, over-sized 1.5” process connection bottom housing with 1/2-inch NPT valved flush port, and oil fill connection port capable of disassembly without loss of filler fluid. Provide 1/2” stainless steel ball valves for the flush port with hose connection. Provide 1.5” stainless steel ball valves for the process connection. Coordinate process connection type (threaded or flanged) with the process piping supplied. Seals shall be as manufactured by Ashcroft, or approved equal.

F. The complete gauge assembly and appurtenances shall be fully assembled and tested prior to field mounting. A 1/2-inch stainless steel isolation ball valve shall be provided for each gauge assembly.

G. Pressure gauges shall be as manufactured by Ashcroft, US Gauge, Marshalltown, Marsh, or approved equal.

2.06 PRESSURE SWITCHES

A. Provide low and high pressure switches for each of the sludge feed pumps. Pressure switches shall be single or dual action with an adjustable setpoint for the process requirement and/or as specified herein. Switches shall be diaphragm or piston operated

and activated S.P.D.T. snap action switches on increasing or decreasing pressure. Minimum differential shall be less than 10 percent of the range. Deadband shall be adjustable. Allowable surge pressure shall be a minimum 1.5 times the range. Each pressure switch shall have visible scale.

B. Pressure switches shall have a contact rating of 10 amperes at 120 volts AC. Pressure switches shall be in NEMA 4X enclosures. Switches shall have a repeatable accuracy of 1 percent of range. Pressure switches shall be isolated from the process fluid by a diaphragm seal or an isolation ring in locations as shown on the Contract Drawings and/or as specified. Wetted parts materials shall be compatible with the process fluid for corrosion resistance. Pressure switches shall be manufactured by Ashcroft.

C. Switch assemblies shall be liquid filled and may be combined with the associated pressure gage mounted to the same diaphragm seal assembly.

2.07 LEVEL FLOAT

A. Provide a high level float to replace the high level float in the existing lift station. Level switch shall be of the direct acting float-operated design comprised of a hermetically sealed, approximately 5 inch diameter plastic casing float, containing microswitches and flexibly supported by means of a heavy neoprene or PVC jacket, with three conductor cable a minimum of 20 feet in length. Unless otherwise specified, media specific gravity is 0.95 to 1.05. Microswitches shall be one normally open and one normally closed, 5A-115V AC capacity. Float switch shall be Model ENM as manufactured by Flygt, or equivalent as manufactured by Anchor Scientific.

2.08 PRODUCTS AND PROGRAMMING REQUIREMENTS

A. Programming software for both the hypochlorite system PLC and plant workstation Citect displays shall be completed using the County's standard, existing programming software, current version.

B. Transient Voltage Surge Suppressors (TVSS): Provide surge protection for the incoming 120V power to and analog output from the new RAS flow transmitters and at the existing panel end for all new analog signals (if not already available as spare devices in the panel). TVSS devices shall match existing components for other signals (or approved equal) at the facility for both the field end and the existing PLC control panel end.

C. Programming Requirements:

1. SLUDGE FEED PUMP AND GRINDER CONTROL: Control of the sludge feed pumps shall be as programmed through the centrifuge panel PLC supplied under Division 11. Controls shall be from the centrifuge panel only (no remote override). Provide programming of the fiber optic communications link and the plant Citect displays for status monitoring of the pumps and grinders. Interface between the Centrifuge Control Panel and the plant SCADA network for display on Citect includes:
    - Pump Running, VFD Fault, and In Remote status
    - Pump Reset and Hand/Off/Auto selection
    - Pump low seal water, High Motor Temp, and VFD High Temp alarms
    - Pump Low Suction and High Discharge Pressure alarms

- Pump Run Dry alarm
- Grinder Running, Fault, and In Remote status
- Grinder Hand/Off/Auto selection
- Pump and Grinder Runtime (hours and 10nths of hours)
- Sludge flow rate in gpm
- Pump speed 0-100%
- Pump manual speed adjustment when in HAND
- Pump current (amps)
- Sludge Feed Flow Setpoint
- Pump 1/2 Selection

2. POLYMER FEEDER CONTROL: Control of the polymer feeders shall be as programmed through the centrifuge panel PLC supplied under Division 11. Controls shall be from the centrifuge panel only (no remote override). Provide programming of the fiber optic communications link and the plant Citect displays for status monitoring of the feeders. Interface between the Centrifuge Control Panel and the plant SCADA network for display on Citect includes:
    - Feeder Running, Fault, and In Remote status
    - Polymer feed rate (gph)
    - Feeder speed 0-100%
    - Feeder Hand/Off/Auto selection
    - Feeder manual speed adjustment when in HAND
    - Feeder Dose setpoint
    - Feeder Low Flow alarm
    - Polymer Tote Weight indication (both totes)
    - Polymer Warning Weight alarm
    - Low Polymer Weight alarm
    - Polymer Tote 1/2 Selection

3. CONVEYOR CONTROLS: Control of the dewatered cake conveyor and associated diverter gates shall be as programmed through the centrifuge panel PLC supplied under Division 11. Controls shall be from the centrifuge panel only (no remote override). Provide programming of the fiber optic communications link and the plant Citect displays for status monitoring of the conveyor operation. Interface between the Centrifuge Control Panel and the plant SCADA network for display on Citect includes:
    - Conveyor Running, Fault, and In Remote status
    - Conveyor Low Speed alarm
    - Conveyor Runtime (hours and 10nths of hours)
    - Conveyor Hand/Off/Auto selection
    - Conveyor / System Emergency Stop alarm
    - Diverter gate Open/Close/In Remote/Fault status for each gate
    - Diverter gate Open/Close/Auto selection
    - Truck bed level for each level sensor

4. CENTRIFUGE CONTROL: Control of the centrifuge and associated equipment shall be as programmed through the centrifuge panel PLC supplied under Division 11. Controls shall be from the centrifuge panel only (no remote override). Provide programming of the fiber optic communications link and the plant Citect displays for status monitoring of the centrifuge operation. Interface between the Centrifuge

Control Panel and the plant SCADA network for display on Citect includes:

- Centrifuge Main and Secondary Drives Running
- Main Drive speed
- Main Drive current (amps)
- All twelve alarm conditions registered on the alarm page
- Common alarm indication (initiated by any alarm)
- Centrifuge Runtime (hours and 10nths of hours)
- Startup or Shutdown mode indication
- Centrifuge manual/auto mode status
- Wash water valve open/close status
- Diverter gate Open/Close/In Remote/Fault status
- Diverter gate Open/Close/Auto selection
- Centrifuge solid and liquid end bearing temperature
- Centrifuge vibration

5. HYPOCHORITE FEED CONTROL: Hypochlorite shall be fed based on a dose setpoint in proportion to the plant effluent flow rate. Output to feed pump shall be calculated as follows:

   Output = [Flow (mgd) x Dose (ppm) x 8.34] / [Pump Max Capacity setting (lbs/day) x pump stroke length setting (%)]

   Example: Flow = 4.0, Dose = 3 ppm, Pump Capacity = 2,400 ppd, Stroke = 15%,
   Output = (4 x 3 x 8.34) / (2,400 x 0.15) = 27.8%

   Flow to each of two feed points shall default to be 1/2 (one half) the total effluent flow. If one of the two contact chambers is out of service, operators shall be able to place a chamber out of service and the remaining feed point pump output shall be based on the full effluent flow.

   As part of this control function, provide dose setpoint trim based on an adjustable chlorination residual concentration setpoint. As the actual concentration varies from the setpoint, raise the dose if the residual falls below the setpoint and lower the dose as the residual rises above the setpoint. Trim the dose setpoint by an adjustable Dose Trim amount for an adjustable Residual Deviation percentage. For example, if the Dose Trim were set to 0.2 ppm and the Residual Deviation percentage were set to 5%, when the actual residual is more than 5% higher than setpoint, trim the dose by 0.2 ppm and trim by the same amount each 5% increase over setpoint.

   FEED PUMP SELECT – Pump 1 (east pump) shall normally feed discharge point 1 (south chamber). Pump 3 (west pump) shall normally feed discharge point 2 (north chamber). Pump 2 (middle pump) shall act as the backup. Provide a 1/OFF/2 software selector switch to select the feed point for the backup (middle) feed pump. If either 1 or 2 is selected, the backup pump shall be started to feed that feed point and the associated dedicated pump shall be turned off.

   FEED POINT LOW FLOW – Provide an alarm if the flow rate to either feed point (as measured by the in-line flow meters) goes below an adjustable setpoint and shut off the associated feed pump.

TANK LEVEL ALARMS AND INTERLOCK – If the level in the hypochlorite storage tank rises above a high level setpoint, an alarm shall alert operators. If the level falls below a low level setpoint, a warning alarm shall alert operators to order more product. If the level falls below a low low level setpoint, the pumps shall be stopped until reset at the panel or from SCADA.

The pump skip is provided with local controls for each pump as described and specified in Division 11. Display the following locally on the panel OIU and on the SCADA display:

- Run status for each feed pump
- In Remote status for each feed pump
- Fail alarm for each feed pump
- Emergency shower in use indication
- Hand/Off/Auto HMI selector switch for each feed pump
- HMI stroke setting for each feed pump (for calculating chemical use)
- 1/OFF/2 HMI selector for backup feed pump
- Contact Chamber OUT OF SERVICE selection for each of the north and south chambers
- Feed rate from the flow meters supplied at each discharge point
- LOW FLOW cutoff for each feed point
- Manual HMI Speed control for each feed pump
- Chemical use (calculated daily total)
- Dose setpoint
- Tank level indication and high, low, and low low alarm indication

D. REQUIRED CITECT DISPLAYS

1. Plant Overview Display – revise the existing display to display the new hypochlorite feed pumps, flow rate, and tank levels as well as show the basic operational parameters for the centrifuge system (centrifuge and pumps running).

2. Totals and Runtime Popup – update the existing display to add the sludge feed pumps, grinders, conveyor and centrifuge drives.

3. Dewatering System Display – new display to depict the required parameters as previously listed.

4. Hypochlorite System Display – new display to depict the required parameters as previously listed.

5. Alarm Summary – display all dewatering and hypochlorite system alarms with indication, acknowledgement, historical logging, and reset features similar to existing alarm displays.

6. Historical Displays – add signals for all flows, pressures, and level signals to the existing historical logging data collection system and allow these signals to be displayed on the historical trend displays.

D. PLC Programming: Programming of the hypochlorite PLC shall follow all formatting, documentation, conventions, data transfer, and signal conditioning standards utilized and

established by the County for plant PLC ladder logic programming. Program software shall match the type and version utilized by the County throughout the plant.

E. Programming revisions required for the plant network communications and operator interface software shall be performed by the control system programmer. Signal interface shall be coordinated with the new hypochlorite and dewatering system PLC programming to match registers, IP, and internal addresses to completely integrate the new hypochlorite and centrifuge systems into the plant monitoring and control system. All operator interface functions and graphics are to be supplied to allow complete and full access, automated control setting, manual control override, and remote status monitoring and recording of the hypochlorite and dewatering systems. Programming revisions required for the plant network communications and Citect software shall be made such that functions and graphic displays match that supplied for similar existing devices and controls.

F. Surveillance Camera Signals: Coordinate with the camera supplier under Section 13500 to retransmit the fiber optic communications from the media converters within the Centrifuge Control Panel over the PLC fiber network to the County's existing video surveillance base system. Provide all cabling and interface devices as needed to complete the video monitoring circuits.

2.10 FILL PANEL

A. Fabricate, furnish and install a Lee County standard chemical fill panel for the hypochlorite pumps. Panel shall be as shown on the diagrams included at the end of this section, including the specific components listed in the Bill of Materials for the fill panel, no substitutions.

2.11 HYPOCHLORITE FEED FLOW METER

A. Provide one new flow meter to match the existing hypochlorite feed flow meter (which is to be re-used and relocated). The new and relocated existing meters shall measure the flow to each hypochlorite feed point as close to the feed point as possible.

B. The new flow meter shall match the existing unit. Meter shall be an Endress + Hauser Proline Promass 80 series Coriolis single tube flowmeter. Measuring principle shall be based on the controlled generation of Coriolis forces and operate independently of physical fluid properties such as viscosity or density.

- Nominal diameter: match existing (~1/2")
- Current output: full scale 4 to 20 mA
- Power: loop-powered, 11 mA consumption, 24Vdc
- Output data: Volume flow, gph
- Housing: NEMA4X, suitable for outdoor installation, Central Florida, watertight and corrosion resistant.
- Accuracy: ±0.05 % of full scale
- Repeatability: ±0.05% of range
- Installation: vertical, upward flow, wall mounted (include Type 316 stainless steel mounting hardware and concrete anchors)

- Wetted parts (flange, measuring tube): Alloy C22 suitable for hypochlorite exposure.
- Non-wetted parts: Type 316 stainless steel
- Process pipe connection: SCH80PVC transition, true-union type

PART 3 – EXECUTION

3.01 SCHEDULE OF PAYMENT

A. Progress payments shall be in accordance with the approved Payment Schedule. The instrumentation programmer will be allowed to request partial payments for submittals, initial download of programming, and final completion.

B. The payment schedule and project milestones shall be defined in Division 1.

3.02 TESTING REQUIREMENTS

A. The CONTRACTOR shall provide the services of experienced factory trained technicians, tools and equipment to field calibrate, test, inspect, and adjust all equipment in accordance with manufacturer's specifications and instructions.

B. The proper control of all final control elements shall be verified by tests conducted in accordance with the requirements specified herein.

C. All modulating final control elements shall be tested for appropriate speed or position response by applying power and input demand signals, and observing the equipment for proper direction and level of reaction. Each final control element shall be tested at 0, 25, 50, 75, and 100 percent of signal input level and the results checked against specified accuracy tolerances. Final control elements which require turndown limits such as VFD's shall be initially set during this test.

D. Prior to control system startup and testing, each monitoring and control loop shall be tested on an individual basis from the primary element to the final element, including the operator work station or loop controller level, for continuity and for proper operation and calibration.

E. Signals from transducers, sensors, and transmitters shall be utilized to verify control responses. Simulated input data signals may be used subject to prior written approval by the Engineer. All modes of control shall be exercised and checked for proper operation.

F. Control system startup and testing shall be performed to demonstrate complete compliance with all specified functional and operational requirements. Testing activities shall include the simulation of both normal and abnormal operating conditions.

G. Each loop and control strategy test shall be witnessed and signed off by both the Contractor (or designee) and the Engineer upon satisfactory completion.

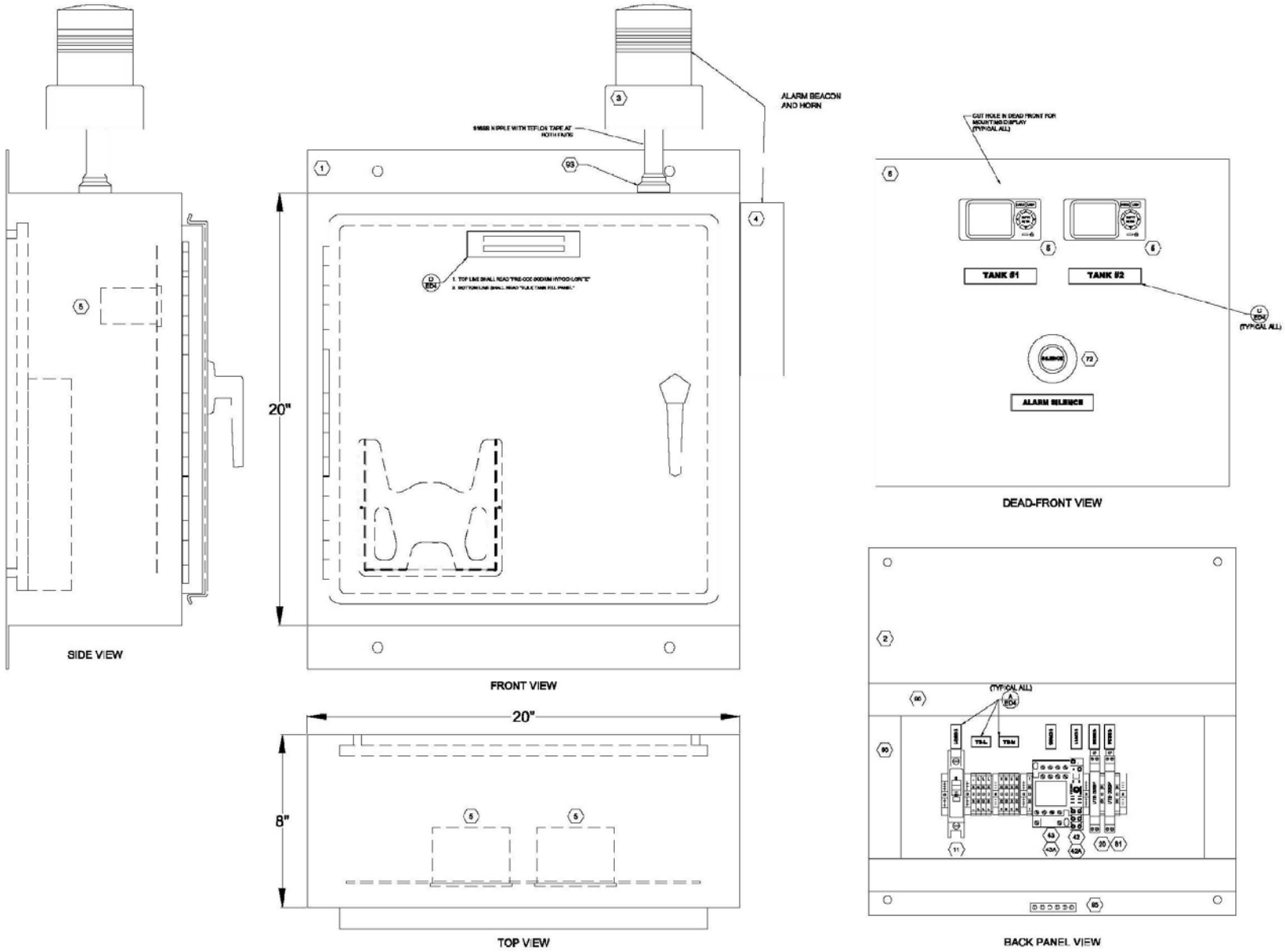
H. Upon completion of the startup tests and prior to final system acceptance, the new controls shall be tested under normal operating conditions, initiated either automatically or manually, over a 30 day test period to demonstrate continuous reliable operation as intended.

I. If the system fails the 30 day availability test, the 30 day test period shall be restarted after the failed component or software is repaired / replaced and full operation is restored.

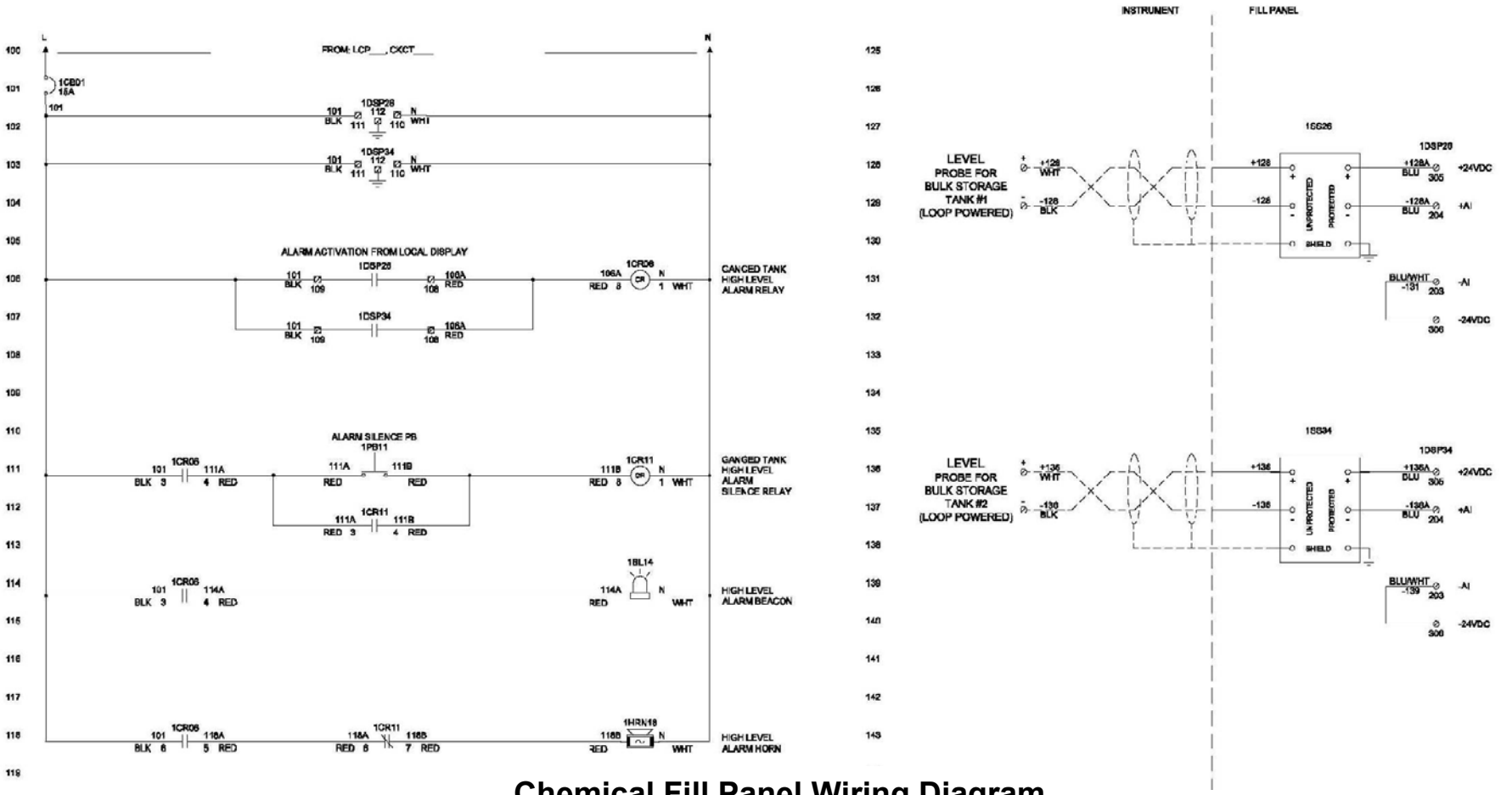
3.03 FINAL ACCEPTANCE

A. Final acceptance of the instrumentation programming will be determined complete by the Engineer, and shall be based successful completion of startup testing and training of the operations staff to the City's satisfaction.

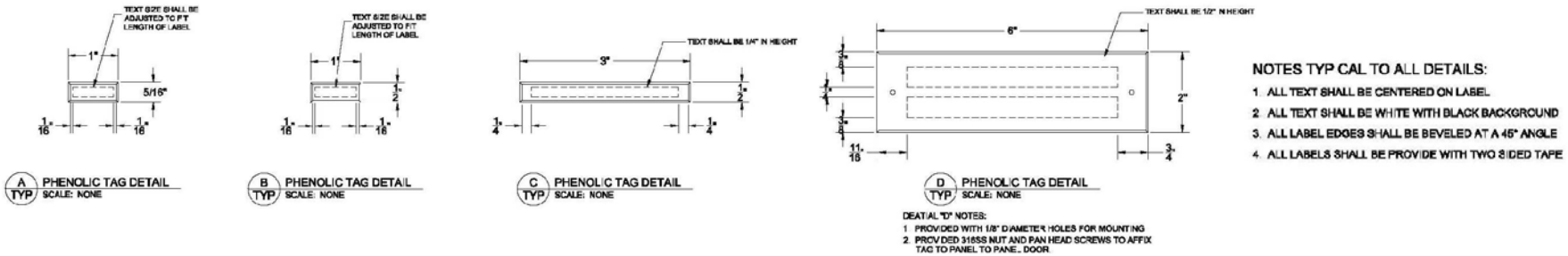
– END OF SECTION –



Chemical Fill Panel Elevations



Chemical Fill Panel Wiring Diagram



BILL OF MATERIALS

QTY	ID	DESCRIPTION	MFG.	SUPPLIER	PART #	REFERENCE / NOTES	UL
1	1	ENCLOSURE (20"X20"X8") W/DWG POCKET	SCHAEFER	SCHAFFER	SPN4SS-20208	4X 304SS, POWDER COATED WHITE, 3PT LATCH	NITW . E10894
1	2	BACK PANEL (13X13)	SCHAEFER	SCHAFFER	SPP-2020	CARBON STEEL POWDER COATED WHITE	NITW . E10894
1	6	DEAD FRONT FOR ENCLOSURE	SCHAEFER	SCHAFFER		ALUMINUM	
1	3	ALARM BEACON	FEDERAL SIGNAL	HD ELECTRICAL SUPPLY	LP3P-120A	1BL14	UEES . E182485
1	4	AUDIBLE ALARM HORN	FEDERAL SIGNAL	HD ELECTRICAL SUPPLY	350-120VAC-TR	1HRN18	UCST . E4813
0	NA	RADAR LEVEL TRANSDUCER, NOTE 2	OHMART VEGA	CLASSIC CONTROLS	PS61.LDXANPHKNXX	WILL BE FIELD MOUNTED NOT PANEL MOUNTED	CLASS 2
2	5	PANEL D SPLAY FOR LEVEL TRANSDUCER	YOKOGAWA	CLASSIC CONTROLS	UM33A-000-10/LP	1DSP25, 1DSP34	CLASS 2
1	11	CIRCUIT BREAKER 15 AMP	SQUARE D	HD ELECTRICAL SUPPLY	720-COU115	1CB01	WJAZ . E33117
2	20	ANALOG SURGE SUPRESSOR	CRITEC	BCI TECHNOLOGIES	UTB-30SP	1SS26, 1SS34	
1	42	OMRON RELAY BASE	OMRON	AA ELECTRICAL SUPPLY	P2FR-08-E	1CR11	SWIV2 . E37929
1	42A	OMRON RELAY	OMRON	AA ELECTRICAL SUPPLY	G2R-2-SN-AC120	1CR11	NLDX . E3125
1	43	AB RELAY BASE	AB	AA ELECTRICAL SUPPLY	700-HN139	1CR08	
1	43A	AB RELAY	AB	AA ELECTRICAL SUPPLY	700-HF34A1	1CR08	
1	72	PUSH BUTTON W/ NO-NC CONTACTS	SQUARE D	HD ELECTRICAL SUPPLY	9001SKR1B	1PB11 (UL under 9001-KA1)	NKCR . E78403
AR	80	TERMINAL BLOCK	SQUARE D	HD ELECTRICAL SUPPLY	AB1VV435U		XCFR2 . E164359
2	81	GROUNDING TERMINAL BLOCK	SQUARE D	HD ELECTRICAL SUPPLY	AB1TP435U		XCFR2 . E164359
AR	82	TERMINAL BLOCK END PLATE	SQUARE D	HD ELECTRICAL SUPPLY	AB1AC24		
AR	83	TERMINAL BLOCK END CLAMP	SQUARE D	HD ELECTRICAL SUPPLY	AB1AB8M3S		
AR	84	DIN RAIL (35 mm)	SQUARE D	HD ELECTRICAL SUPPLY	9080MH379		
AR	85	TERMINAL LABELS 1-10	SQUARE D	HD ELECTRICAL SUPPLY	AB1B5-10		
AR	86	TERMINAL LABELS 11-20	SQUARE D	HD ELECTRICAL SUPPLY	AB1B5-20		
AR	87	TERMINAL LABELS 21-30	SQUARE D	HD ELECTRICAL SUPPLY	AB1B5-30		
AR	90	WIRE DUCT 1.5"	NSI	HD ELECTRICAL SUPPLY	PC1540-LSN-W		
1	93	1/2" MYERS HUB		HD ELECTRICAL SUPPLY	STA-1	1BL14	
1	95	6 LUG GROUND BAR KIT	SQUARE D	HD ELECTRICAL SUPPLY	1170 PK6GTA		QEUY2 . E6294
AR	100	ENGRAVED PHENOLIC TAGS				SEE ED-9 FOR QTY. AND ED-4 FOR DETAILS.	

NOTES:

1. COMPONENTS CAN BE REPLACED WITH ENGINEER APPROVED EQUAL
2. LEVEL TRANSDUCERS PROVIDED BY LCU

Chemical Fill Panel

LEE COUNTY UTILITIES
Control, Telemetry, Security and SCADA Integration Services
Continuing Contract

SCOPE OF WORK

Work will be performed at the Water and Wastewater Plants as well as remote sites that are part of the plant's operations. This Contractor will be the approved contractors for new projects that the County puts out for bid.

Emergency repairs at times other than normal working hours. The Contractor shall be in a position to be available on a twenty-four (24) hour basis, three hundred sixty-five (365) days per year, including holidays, for such emergency work. The Contractor shall supply the County an emergency phone contact list. Emergency repairs performed by contractors will be on a time and material basis as per contract.

A.	Programmer Per Hour	Normal Time	Overtime
B.	Field Technician Per Hour	Normal Time	Overtime

The Contractor shall have an office located in Florida and not more than 150 miles from Lee County. This office shall have adequate staffing available to carry out any projects requested by the County in a timely manner.

This contract will be set up at two levels:

Level one: This contract will allow for smaller projects up to 100,000.00 the level were no bond is required.

Level two: This contract may require bonds and would be larger projects over the 100,000.00 range.

The Contractor will specify what level their company is submitting for this RFQ.

The Contractor shall supply the County with full documentation, which will include all PLC logic and descriptors, 3-D generational files for the SCADA or HMI, any associated files for SCADA or HMI systems, drawings in Auto Cad format, training manuals, and O&M manuals both electronically and on a CD. The Contractor shall also provide the County with a full hard copy of the O&M manuals. The contractor shall use the HMI standard that the County has developed. This standard will be given at time of project or as needed basis.

1. Company Qualifications:
    a. Company name, address and telephone number
    b. Copy of Contractors License for Lee County (as applicable)
    c. Proof of insurance and policy limitations including Workman Compensation
    d. Largest project undertaken accompanied by a brief overview
    e. List of past or pending litigations or judgments within the last 5 years. Provide a brief description if applicable.

2. Contractor Qualifications: Contractors shall provide, in detail, their credentials for providing control, telemetry, security and SCADA integration services and any information which

documents successful and reliable experience in past performance, especially those performances related to the requirements of this RFQ. Contractor shall be a certified Citect Silver level or better integrator. Proof of the certification will need to be submitted with the RFQ package.

3. The contractor shall have proof of completed projects with Allen Bradley or Modicon PLC system. The on site programmer shall be Citect trained and certified. The Contractor shall program the PLC in ladder logic, no other language will be used unless pre-approval by the County.
4. Include a description of the Contractor's history and number of years in operation. Related experience shall be restricted to those assignments undertaken within the last five (5) years. Evidence of full project completion and schedule under or over run is required.

5. Staff Credentials: Contractor's shall include a list of the proposed technicians who will be working on the County's equipment or providing new installations as assigned. These technicians shall have verifiable experience in completed water and waster water projects in the state of Florida.
   The contractor shall be required to provide only those technicians that have been approved by the County to perform services within the scope of the RFQ. In the event of new personnel being hired during the course of the contract, the Contractor will be required to submit the resumes of the new employee(s) for County approval before performing any work requested by the County. The Contractor shall provide proof of knowledge and qualifications for new personnel, including; certifications or licenses as related to the work to be performed.

6. References: A list of three (3) applicable references is to be provided. Typical references include customers and other governmental agencies that have contracted for similar services, and engineering consultants or other professionals whose design was incorporated or undertaken by the Contractor within the last five (5) years. The list shall include:

   a. Company name and address.
   b. Contracting officer and telephone number.
   c. Technical representative and telephone number.
   d. A brief, written description of the project.
   e. Project value quoted for integration services work for each project.

7. Software Application Qualifications: Provide a detailed listing of SCADA and PLC programming software that you are qualified to modify, install, or program. The software used for programming the PLC's must match the set County standards.

8. Work Detail Qualifications: Provide a portfolio of previous work that includes pictures of instrumentation installations, control cabinet construction, control cabinet layout, PLC terminations, field wire terminations, and any other relevant work such as security systems, fiber optic systems, and communication systems. Include a list of every drawing typically issued with a project and an example of it. Include at least one copy of a theory of operation, training manual, and O&M manual provided as part of a completed project. Also, include a detailed list of projects that have been previously completed for Lee County Utilities or other similar water or waste water utility projects.

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