

TECHNICAL SPECIFICATIONS

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West O'Daniel Seep Recovery Trench

**Snyder Oil Field
Howard County, Texas**

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RAILROAD COMMISSION OF TEXAS

Oil and Gas Division

Site Remediation and Special Response

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AUGUST 10, 2007

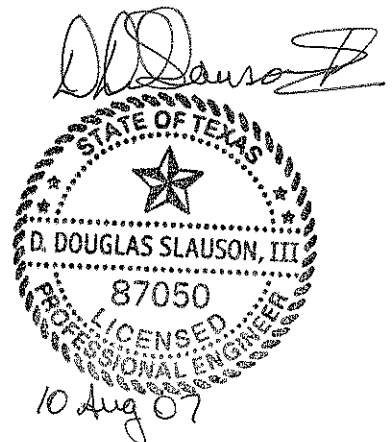


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SECTION 01100
SUMMARY OF WORK

PART 1. GENERAL

1.01 SITE LOCATION

A. The West O'Daniel Seep site is located within the Snyder Oil Field approximately 5.5 miles east of Coahoma, Texas. The limits of construction are on private property, within a barbed wire fence, immediately adjacent to, and on the northern edge of S. Snyder Field Road, just east of its intersection with S. CR-53. Access to the site will be via a Contractor provided gravel driveway from S. Snyder Field Road. The driveway shall be incorporated in the final grading of the gravel tank yard.

1.02 DESCRIPTION OF SITE ACTIVITIES

A. The construction activities at the site shall consist of the following:

1. excavation of a groundwater recovery trench, 300 feet long by 3 feet wide, in the location shown on the Drawings;

2. installation of two 12-inch diameter recovery sumps and two 12-inch observation wells within the recovery trench;

3. backfill the recovery trench with filter pack sand;

4. cover trench backfill with an HDPE membrane covered by a cap of compacted select fill/native soil;

5. plumbing the sump to a pump with 2" PVC pipe to API 12P standard storage tanks;

6. grading, paving with flexible base, and fencing a 200' by 120' tank yard to allow for entry and exit of trucks to empty the tanks for disposal;

7. providing a 10' by 10' prefabricated equipment shed, with included electrical connections, within the tank yard;

8. associated electrical work to provide power to the pump and other equipment; and

8. all required environmental controls per applicable rules and regulations.

1.03 SAFETY

A. The Contractor will be required to develop a Health and Safety Plan (HSP) and designate an approved on-site safety representative who is responsible for ensuring that the HSP is followed by all on-site Contractor employees.

1.04 RELATED REQUIREMENTS

A. The Contractor shall consult all other sections of these specifications which further describe the work requirements for performance of this contract.

PART 2. PRODUCTS

NOT USED

PART 3. EXECUTION

NOT USED

END OF SECTION

SECTION 01300
SUBMITTAL PROCEDURES

PART 1. GENERAL

1.01 DEFINITIONS

A. Definitions of submittals are as follows:

1. Data: Submittals which provide calculations, descriptions, or documentation regarding the work.

2. Drawings: Submittals which graphically show relationship of various components of the work, schematic diagrams of systems, details of fabrication, layouts of particular elements, connections, and other relational aspects of the work.

3. Instructions: Preprinted material describing installation of a product, system or material, including special notices and material safety data sheets, if any, concerning impedances, hazards, and safety precautions.

4. Schedules: Tabular lists showing location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work.

5. Statements: A document, required of the Contractor, or through the Contractor, from a supplier, installer, manufacturer, or other lower tier Contractor, the purpose of which is to confirm the quality or orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel, qualifications, or other verifications of quality.

6. Reports: Reports of inspections or tests, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used shall be identified and test results shall be recorded.

7. Certificates: Statement by an official authorized to certify on behalf of the manufacturer of a product, system or material, attesting that the product, system or material meets specified requirements. The statement must be dated after the award of the contract, must state the Contractor's name and address, must name the project and location, and must list the specific requirements which are being certified.

8. Samples: Samples, including both fabricated and unfabricated physical examples of materials, products, and units of work as complete units or as portions of units of work.

9. Records: Documentation to record compliance with technical or administrative requirements.

10. Operation and Maintenance Manuals: Data which forms a part of an operation and maintenance manual.

1.02 APPROVED SUBMITTALS

A. The approval of submittals by the Railroad Commission of Texas (RRC) Authorized Representative shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory. Approval will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work. After submittals have been approved by the RRC Authorized Representative, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.03 DISAPPROVED SUBMITTALS

A. The Contractor shall make all corrections required by the RRC Authorized Representative and promptly furnish a corrected submittal in the form and number of copies specified for in the initial submittal. If the Contractor considers any correction indicated on the submittals to constitute a change to the contract, the Contractor will promptly notify the RRC Authorize Representative.

1.04 WITHHOLDING OF PAYMENT

A. Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

PART 2. PRODUCTS

NOT USED

PART 3. EXECUTION

3.01 GENERAL

A. The Contractor shall make submittals as required by the specifications. The Railroad Commission Authorized Representative may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections. Units of weights and measures used on all submittals shall be the same as those used in the contract drawings. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements. Prior to submittal, all items shall be checked and approved by the Contractor and each item shall be stamped, signed and dated by the Contractor indicating action taken. Proposed deviations from the contract requirements shall be clearly identified.

Submittals requiring approval shall be scheduled and made prior to the acquisition of the material or equipment covered thereby. Samples remaining upon completion of the work shall be picked up and disposed of in accordance with the manufacturer's Material Safety Data Sheet and in compliance with existing laws and regulations.

3.02 SCHEDULING

Submittals covering component items forming a system or items that are interrelated shall be scheduled to be coordinated and submitted concurrently. Certifications to be submitted with the pertinent drawings shall be so scheduled. Adequate time (at least 10 work days) shall be allowed for review and approval. No delay damages or time extensions will be allowed for time lost in late submittals.

3.04 SUBMITTAL SCHEDULE

A. Submittals shall be made as follows:

1. Transmit each submittal with transmittal letter.
2. Sequentially number the transmittal letter. Revise submittals with original number and a sequential alphabetic suffix.
3. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate.
4. Apply Contractor's stamp, signed or initialed certifying that review, verification of Products required, field dimensions, adjacent construction Work, and coordination of information, is in accordance with the requirements of the Work and Contract Documents. Submittals will be returned if they have not been reviewed by the Contractor prior to submittal.
5. Schedule submittals to expedite the Project and deliver to the RRC Authorized Representative at the mailing address provided during the preconstruction meeting. Coordinate submission of related items.
6. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work.
7. Provide space for Contractor and RRC Authorized Representative review stamps.
8. Revise and resubmit, identify all changes made since previous submission.
9. Distribute copies of reviewed and approved submittals as appropriate. Instruct parties to promptly report any inability to comply with provisions.

10. Submittals not requested will not be recognized or processed.

B. Deviations: The Contractor shall set forth in writing the reason for any deviations and annotate such deviations on the submittal. The RRC reserves the right to rescind inadvertent approval of submittals containing unnoted deviations.

3.05 CONTROL OF SUBMITTALS

A. The Contractor shall carefully control his procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date.

END OF SECTION

SECTION 1500
TEMPORARY FACILITIES

PART 1. GENERAL

1.01 SCOPE

This section covers the furnishing of all appliances, labor, materials, tools, transportation, and services required to perform and complete all preliminary work and temporary construction required for the construction and site as indicated on the drawings and as specified.

1.02 TEMPORARY ELECTRIC SERVICE

Electric service required in the performance of the contract shall be furnished and paid for by the Contractor who shall furnish, install, and maintain all temporary poles and overhead construction, transformers, meters, drops, and other wiring and fittings for both light and power at locations required in the work, and shall bear the cost of making the service connections.

1.03 SANITARY FACILITIES

The Contractor shall provide, install, and maintain, for the duration of the work, temporary outside toilet facilities for the use of the workmen. The toilet facilities shall be adequate, housed on a weather-tight and elevated floored structure and located advantageously. The toilet shall be kept in a clean and sanitary condition until the completion of the work, then shall be removed from the site, and the portion of the site occupied by the same properly cleaned up, graded, and left in acceptable condition.

1.04 PUMPING AND DRAINAGE

Surface or subsurface water or other fluid shall not be permitted to accumulate in excavations. Should such conditions develop or be encountered, the water or other fluid shall be controlled and suitably disposed of by means of temporary pumps, piping, drainage lines and ditches, dams, or other methods as approved by the Railroad Commission of Texas (RRC) Authorized Representative.

1.05 DUST PALLIATION

Throughout the entire contract period, the Contractor shall effectively dust-palliate the working area, roads used in the operations, and involved portions of the site which such frequency as will satisfactorily allay the dust during all hours that work is being performed.

1.06 CLEANING

The Contractor shall from time to time remove all dirt and rubbish caused by the work from the structures and site. At completion of the work, the Contractor shall thoroughly clean the interior and exterior of all building, structures, equipment, etc., including hardware, floors, roofs, sills,

ledges, glass or other surfaces where debris, dust, dirt, and paint spots may have collected. All glass shall be washed clean at completion.

1.07 PAYMENT

No separate payment will be made for work covered under this section of the specifications and all costs in connection therewith shall be included in the contract price for the items to which the work pertains.

PART 2. PRODUCTS

NOT USED

PART 3. EXECUTION

NOT USED

END OF SECTION

SECTION 02100
GENERAL SITE PREPARATION

PART 1. GENERAL

1.01 SCOPE

A. This section covers the requirements for general site preparation for the project site.

1.02 DEFINITIONS

A. Clearing: Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation, miscellaneous debris including downed timber, snags, brush, and rubbish occurring in the areas to be cleared.

B. Grubbing shall consist of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing areas.

PART 2. PRODUCTS

NOT USED

PART 3. EXECUTION

3.01 GENERAL

A. The Contractor shall prepare areas requiring excavation, clearing, staging, stockpiling or as otherwise indicated on the Drawings by minimal clearing and grubbing and installing a minimum of new roads or upgrading existing roads as necessary to proceed with the Work. The amount of site clearing shall be determined by the Contractor prior to mobilization.

3.02 CLEARING AND GRUBBING

A. Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface. Vegetation to be left standing, as directed by the Railroad Commission of Texas Authorized Representative, shall be protected from damage incidental to clearing, grubbing, and construction operations by the erection of barriers or by other means as the circumstances require.

B. Material to be grubbed shall be removed to a depth of not less than 4 inches below the original surface level of the ground. Depressions made by grubbing shall be filled with satisfactory material and compacted to make the surface conform to the original adjacent surface of the ground.

3.03 DISPOSAL OF MATERIAL

A. Any material generated as a result of clearing and grubbing shall be the Contractor's responsibility and shall be disposed of in an approved location. The Contractor shall obtain all necessary permits and approvals for disposal of materials and submit to the RRC for information.

3.04 WELL PROTECTION

A. The Contractor shall identify and locate all groundwater monitor wells associated with the project area. These shall be staked and flagged as appropriate so that they are visible to all construction personnel. Site personnel, operators, and supervisors shall be informed as to the identification of monitor wells and shall be instructed under no circumstances shall wells be damaged in any way. Any damage to wells during the course of construction under this contract will be repaired at the Contractor's expense, up to and including the re-installation of new wells, and abandonment of damaged wells, if required.

END OF SECTION

SECTION 02200
ENVIRONMENTAL PROTECTION

PART 1. GENERAL

1.01 SCOPE

A. The contractor shall perform all work in such a manner as to minimize the polluting of air, water, or land, and shall, within reasonable limits, control noise and the disposal of solid waste materials, as well as other pollutants. The Contractor shall also conduct the work in a manner to minimize the disturbed area.

1.02 PROTECTION OF WATER RESOURCES

A. The Contractor shall control the disposal of fuels, oils, bitumens, calcium chloride, acids or harmful materials, both on and off site and shall comply with all applicable Federal, State, County and Municipal laws concerning pollution of rivers and streams while performing work under this contract. Special measures shall be taken to prevent chemicals, fuels, oils, greases, bituminous materials, herbicides, and insecticides from entering public waters. Water used in on-site material processing, cleanup, and other waste waters shall not be allowed to reenter a stream if an increase in the turbidity of the stream could result therefrom.

B. Saturated soils contain elevated salt concentrations and shall be managed to prevent water derived from or mixed with (i.e. precipitation) these soils to leave the site or enter a surface water.

C. Storm Water Controls: The Contractor shall develop a plan and employ the use of controls and best management practices to prevent erosion of soils affected by the construction.

1.03 WASTE DISPOSAL

A. Spoils – All spoils from recovery trench excavation shall be segregated into saturated and unsaturated soils. Saturated spoils shall be disposed of at a RRC permitted disposal facility from chloride impacts. Unsaturated soils shall be, as much as possible, utilized for trench backfill. Soils reclaimed for backfill shall meet the backfill requirements of Sections 02320 and 02355, as applicable. Soils not meeting these requirements shall either be reworked to meet backfill requirements, or disposed of on-site as directed by the Railroad Commission of Texas (RRC) Authorized Representative.

B. Other Construction Related Waste - The Contractor shall not dispose of any wastes, other than those addressed in paragraph A, on site. If any waste material is dumped in unauthorized areas, the Contractor shall remove the material and restore the area to the condition of the adjacent undisturbed areas. Where directed, contaminated

ground shall be excavated, disposed of as approved, and replaced with suitable fill material, all at the expense of the Contractor.

1.04 BURNING

A. No open burning shall be allowed under this contract.

1.05 DUST CONTROL

A. The Contractor shall maintain all excavations, embankments, stockpiles, access roads, plant sites, waste areas, and all other work areas free from excess dust to such reasonable degree as to avoid causing a hazard or nuisance to the Public. Approved temporary methods consisting of sprinkling, or similar methods will be permitted to control dust. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs.

1.06 EROSION CONTROL

A. Surface drainage from cuts and fills within the construction limits, whether or not completed, and from borrow and waste disposal areas, shall be graded to control erosion within acceptable limits. Temporary control measures shall be provided and maintained until all disturbed areas covered and compacted, as applicable.

1.07 CORRECTIVE ACTION

A. The Contractor shall, upon receipt of a notice in writing of any noncompliance with the foregoing provisions, take immediate corrective action. If the Contractor fails or refuses to comply promptly, the RRC Authorized Representative may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of a claim for extension of time or for excess costs of damages by the Contractor unless it was later determined that the Contractor was in compliance.

1.08 POST-CONSTRUCTION CLEANUP

A. The Contractor shall, unless otherwise instructed in writing by the RRC Authorized Representative, obliterate all signs of temporary construction facilities such as haul roads, work areas, stockpiles, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. All disturbed areas shall be graded and filled.

PART 2. PRODUCTS

NOT USED

PART 3. EXECUTION

NOT USED

END OF SECTION

SECTION 02250
STORMWATER AND GROUNDWATER MANAGEMENT

PART 1. GENERAL

1.01 SCOPE

A. As necessary to facilitate construction activities, storm water within excavations shall be filtered to remove suspended solids/sediments and discharged downstream. Groundwater encountered within the excavations shall be pumped into temporary holding tanks (to be supplied by the Contractor) and disposed of as directed by the Railroad Commission of Texas Authorized Representative. Water may arise from surface drainage and groundwater infiltration. The Contractor shall be prepared to address both.

B. Deployment of pumps as needed to lift water collected in low areas and conveyed to downstream drainage areas or temporary holding tanks, as appropriate.

C. The Contractor shall design, furnish, install, and maintain erosion and sediment control measures and systems necessary to protect excavations and to prevent the transport of suspended solids in stormwater.

D. The Contractor is responsible for managing stormwater that accumulates in the project area.

1.02 QUALITY ASSURANCE

A. The Contractor shall maintain adequate supervision and control to ensure that the stability of excavated and constructed slopes are not adversely affected by water, that erosion is controlled, and that the flooding of excavations does not occur.

PART 2. PRODUCTS

NOT USED

PART 3. EXECUTION

3.01 STORMWATER AND GROUNDWATER CONTROLS

A. The Contractor shall provide a means to redirect surface water runoff that would normally flow towards the excavations to an area that will not interfere with construction activities.

B. The redirection of stormwater shall be maintained continuously, 24 hours a day, 7 days a week until all excavations have been completely backfilled and compacted.

C. The Contractor shall remove any rainfall or groundwater from within excavations through the use of sumps and sump pumps as needed.

D. All stormwater in contact with the excavation and spoils stockpile shall be filtered using in-line sock filters, filter fabric fence or other acceptable means. The Contractor shall take all necessary precautions to minimize the amount of suspended soil/sediment to be discharged downstream of work areas.

3.02 SUMPS AND PUMPS

A. Excavate pump sumps as required to allow for the removal of water collected in the excavations, and other areas which could become affected.

B. Provide and maintain pumps as necessary to transport the collected water to downstream drainage areas or holding tanks.

3.03 EROSION CONTROLS

A. Temporary erosion controls such as hay bails or silt fences shall be used to inhibit sediment transportation from excavated areas and other areas of disturbed earth as needed. Erosion controls shall be placed immediately downgradient of each area of excavation and elsewhere as necessary to control erosion and sediment transport. The erosion controls shall be of suitable size and construction to control the runoff associated with the 10 year 24 hour storm.

B. The temporary erosion and sediment control measures shall be provided and maintained until restoration of the original grade of the site. The area of bare soil exposed at any given time by construction shall be restricted to a minimum.

C. The Contractor shall comply with all applicable laws and regulations concerning soil erosion, sediment control and stormwater management.

END OF SECTION

SECTION 02300
EARTHWORK

PART 1. GENERAL

1.01 SCOPE

A. This Section includes the following:

1. Preparing subgrades for slabs-on-grade.
2. Excavating and backfilling for buildings and structures
3. Flexible Base for tank yard finished surface.

1.02 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation

B. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

C. Fill: Soil materials used to raise existing grades.

D. Structures: Buildings, footings, foundations, slabs, tanks, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

E. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

1.03 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by the Railroad Commission of Texas (RRC) or others unless permitted in writing by the RRC and then only after arranging to provide temporary utility services according to requirements indicated

1. Notify the RRC not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without the RRC's written permission.
3. Contact utility-locator service for area where Project is located before excavating.

PART 2. PRODUCTS

2.01 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

C. Flexible Base: Type C, Grade 1 Flexible base per TxDOT Specifications, or approved equivalent.

PART 3. EXECUTION

3.01 PREPARATION

A. Protect utilities, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Section 02100, "General Site Preparation."

C. Protect and maintain erosion and sedimentation controls, which are specified in Section 02250, "Stormwater and Groundwater Management," during earthwork operations.

D. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

3.02 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

3.03 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

3.05 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to

prevent windblown dust. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.06 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.07 SOIL FILL

A. Place and compact engineered fill material under slab in layers to required elevations.

B. Place fill on subgrades free of mud, frost, snow, or ice.

3.08 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.09 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

1. Under building slab, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil materials at 95 percent.

3.10 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade as indicated in the plans.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding.

C. Grading inside Building Lines: Finish subgrade to a tolerance of ½ inch when tested with a 10-foot straightedge.

3.11 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions. Scarify or remove and replace soil material to depth as directed by RRC Authorized Representative; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

END OF SECTION

SECTION 02310
BIODEGRADABLE BIO-POLYMER SLURRY

PART 1. GENERAL

1.01 SCOPE

The Contractor shall furnish all labor, materials, equipment and incidentals required to prepare the biodegradable Bio-polymer slurry.

1.02 QUALIFICATIONS

The material specified in this section shall be furnished and coordinated by the manufacturer. The Contractor shall assume responsibility for the satisfactory preparation as specified.

1.03 SUBMITTALS

A. Certificate of compliance: The Contractor shall submit to the RRC a certificate of compliance that shall include the following information:

1. Full product name.
2. Bio-polymer type(s).
3. Bio-polymer slurry physical properties.

B. Source of Water: The Contractor shall submit to the RRC a certificate documenting the source of water to be used in the production of the bio-polymer slurry and ensuring that it is suitable for such use.

1.04 QUALITY CONTROL TESTING

All slurry material that has defects, deterioration, or damage, as determined by the RRC, may be rejected. All rejected material shall be replaced at no cost to the RRC.

PART 2. PRODUCTS

2.01 MATERIAL PARAMETERS

A. General

1. The biodegradable bio-polymer shall naturally degrade to a non-toxic solution once the trench has been backfilled with suitable material. Degraded bio-polymer shall not materially reduce transmissivity of the trench wall, filter pack or form a permanent filter cake on the trench walls which might decrease the transmissivity of the drainage trench/alluvium interface. The contractor shall submit documentation

describing the physical and chemical characteristics of the bio-polymer. Unused bio-polymer slurry shall convert to water containing a minute residual of non-toxic material once the trench is completed.

2. Suitable water shall be obtained for use in production of biodegradable Biopolymer slurry. Water sources for bio-polymer preparation shall be tested by the Contractor prior to beginning excavation and meet the standards required for proper performance.

3. The trench slurry shall consist of a stable suspension of biodegradable biopolymer in water. It is the responsibility of the Contractor to insure that the slurry possesses the necessary properties and monitor the slurry and the trench during excavation. The viscosity, pH and filtrate loss of the slurry shall be monitored by the Contractor to determine when the breakdown of the slurry begins.

4. Admixtures of softening agents, preservatives, dispersants, or retarders may be added to the slurry to permit efficient use of and proper workability of the slurry. Chemical and physical properties and characteristics of any proposed additives shall be submitted with the quality control plan. The Contractor shall have additives necessary to control pH, such as soda ash and lime, sufficient to manage a declining pH situation.

B. Properties

1. The water used for bio-polymer slurry preparation shall conform to the properties determined by the biopolymer manufacturer.

2. The slurry out of the mixing plant shall have a pH of 10.5 or higher and viscosity of 80 to 90 funnel seconds. The Contractor shall maintain a pH of no less than 9.0 and viscosity of no less than 70 funnel seconds (using the Marsh funnel method: API-RP13B procedure) at any time.

PART 3. EXECUTION

3.01 INSTALLATION

A. The Contractor shall provide a slurry mixing plant containing the necessary equipment for preparing and placing the bio-polymer slurry. The mixing and placing equipment shall be in accordance with the manufacturer's specifications. Pumps, valves, hoses, storage supply lines and other equipment shall be provided as required to adequately supply bio-polymer slurry to the trench. Hydration ponds shall not be permitted. Slurry preparation in the trench shall not be permitted.

B. The pH shall be measured after mixing and rechecked at 3 hour intervals during the excavation of the trench and installation of gravel, liner, and piping. This includes a test at the beginning of the work day and one at the conclusion of the work

day. The minimum allowable pH is 9. Values below 9 indicate breakdown of the polymer mixture.

C. The Contractor shall maintain charts of pH and viscosity values over time for each sampling location. Trends of these values will be most useful in understanding if biological degradation of the bioslurry is excessive.

D. The Contractor may allow the trench to remain open overnight and over weekends. However, the trench shall first be topped with slurry and then covered with plywood in accordance with Section 02320. If left open overnight, the slurry shall be tested in accordance with this section at the end of the working day and then immediately at the beginning of the next working day. If left open over the weekend, the slurry shall still be tested at least twice a day with at least an eight hour separation in the testing periods.

E. If the slurry shows signs of degrading then on-call personnel shall be available to respond within 12 hours, or less if necessary, to maintain the slurry. The Contractor is solely responsible for performing the construction of the trench and maintaining the slurry in such a manner as to prevent caving and sloughing of soils into the trench. Any repairs or other consequences of caving and sloughing shall be the sole responsibility of the Contractor.

END OF SECTION

SECTION 02320
RECOVERY TRENCH EXCAVATION

PART 1. GENERAL

1.01 SCOPE

A. Recovery trench excavation shall be accomplished via the biodegradable slurry method. Trench depths as indicated in the drawings shall be maintained, unless deepened at the direction of the RRC.

PART 2. PRODUCTS

NOT USED

PART 3. EXECUTION

3.01. RECOVERY TRENCH EXCAVATION

A. Trench excavation shall be maintained in an open condition by the biodegradable polymer slurry method. Excavation shall be conducted in a manner that provides for a continuous trench 36 inches wide to the required depth along the centerline of excavation. The contractor shall excavate the trench immediately to the depth shown on the drawings at the point where excavation is started. The RRC may direct the Contractor to deepen the trench based on examination of spoils and shall approve the depth of the trench immediately after excavation. The trench shall be constructed without undue interruption until complete.

B. Excavations may be left open overnight but shall be topped with slurry before completion of Work at the end of the day and the trench covered with 3/4 -inch plywood or better. The plywood shall extend at least one foot into undisturbed soil on each side of the trench for support. The slurry shall be tested in accordance with Section 02310 at the close of Work and then again at the beginning of the next working day to determine if the slurry requires maintenance. At the completion of a work week, the trench may be left open over a weekend. However, the trench shall be covered with 3/4-inch plywood or better over the weekend. The plywood shall extend at least one foot onto undisturbed soil on each side of the trench for support. Also, the slurry shall continue to be monitored in accordance with Section 02310.

C. The slurry shall be monitored in accordance with Section 02310 to determine if the slurry requires maintenance. The Contractor is solely responsible for performing the construction of the trench and maintaining the slurry in such a manner as to prevent caving and sloughing of soils into the trench. Any repairs or other consequences of caving and sloughing shall be the sole responsibility of the Contractor.

D. The construction of the trench and use of slurry shall be performed in such a manner as to preclude the deposition of excavated soils and/or slurry outside of the runoff control area (as defined by the silt barriers and berms).

E. Excavated material shall be managed in accordance with excavated soils provisions of Section 02200.

END OF SECTION

SECTION 02340
POLYETHYLENE GEOMEMBRANE LINER

PART 1 GENERAL

1.01 SCOPE

- A. These specifications are for the installation of geosynthetics by the Contractor. A geomembrane 40-mil high density polyethylene liner (HPDE) shall be placed over the filter pack and area surrounding the trench.
- B. The Contractor shall furnish all materials, labor, and equipment for constructing the work included in these specifications and as detailed on the plans.

1.02 SUBMITTALS

- A. The contractor shall furnish the following product data, in writing, to the Railroad Commission of Texas (RRC) Authorized Representative prior to installation of the geomembrane material:
 - 1. Resin Data shall include the following.
 - a. Certification stating that the resin meets the specification requirements (see Section 1.09).
 - 2. Geomembrane Roll
 - a. Statement certifying no recycled polymer and no more than 10% rework of the same type of material is added to the resin (product run may be recycled).
- B. The contractor shall furnish the following information to the RRC Authorized Representative prior to installation:
 - 1. Installation layout drawings
 - a. Must show proposed panel layout including field seams (overlaps) and details
 - b. Must be approved prior to installing the geomembrane
 - 1. Approved drawings will be for concept only and actual panel placement will be determined by site conditions.
- C. The INSTALLER will submit the following to the RRC Authorized Representative upon completion of installation:
 - 1. Certificate stating the geomembrane has been installed in accordance with the Contract Documents
 - 2. Material and installation warranties
 - 3. As-built drawings showing actual geomembrane placement and seams (overlaps) including typical anchor trench detail

1.03 QUALIFICATIONS

- A. MANUFACTURER
 - 1. Geomembrane shall be manufactured by the following:

- a. GSE Lining Technology, Inc.
- b. approved equal
2. MANUFACTURER shall have manufactured a minimum of 10,000,000 square feet of polyethylene geomembrane during the last year.

B. INSTALLER

1. Installation shall be performed by the contractor

1.04 MATERIAL LABELING, STORAGE AND HANDLING

A. Labeling - Each roll of geomembrane delivered to the site shall be labeled by the MANUFACTURER. The label will identify:

- a. manufacturer's name
- b. product identification
- c. thickness
- d. length
- e. width
- f. roll number

B. Storage- The on-site storage location for geomembrane material, provided by the CONTRACTOR to protect the geomembrane from punctures, abrasions and excessive dirt and moisture for should have the following characteristics:

- a. level (no wooden pallets)
- b. smooth
- c. dry
- d. protected from theft and vandalism
- e. adjacent to the area being lined

C. Handling- Materials are to be handled so as to prevent damage.

1.05 GEOMEMBRANE

A. Material shall be smooth polyethylene geomembrane as shown on the drawings.

B. Resin

1. Resin shall be new, first quality, compounded and manufactured specifically for producing geomembrane.
2. Natural resin (without carbon black) shall meet the following minimum requirements:

Property	Test Method	HDPE	LLDPE
Density [g/cm ³]	ASTM D 1505	0.932	0.915
Melt Flow Index [g/10 min.]	ASTM D 1238 (190/2.16)	≤ 1.0	≤ 1.0
OIT [minutes]	ASTM D 3895 (1 atm/200°C)	100	100

C. Gomembrane Rolls

1. Do not exceed a combined maximum total of 1 percent by weight of additives other than carbon black.
2. Geomembrane shall be free of holes, pinholes as verified by on-line electrical detection, bubbles, blisters, excessive contamination by foreign matter, and nicks and cuts on roll edges.
3. Geomembrane material is to be supplied in roll form. Each roll is to be identified with labels indicating roll number, thickness, length, width and MANUFACTURER.
4. All liner sheets produced at the factory shall be inspected prior to shipment for compliance with the physical property requirements listed in section 1.09, B, and be tested by an acceptable method of inspecting for pinholes. If pinholes are located, identified and indicated during manufacturing, these pinholes may be corrected during installation.

D. Smooth surfaced geomembrane shall meet the requirements shown in the following table(s) for the following material(s):

1. Table 1.1 for black HDPE

1.06 EQUIPMENT

A. No welding equipment is required for the installation of HDPE. Welded seams will be replaced with 12-inch overlaps with no welding.

1.07 DEPLOYMENT

- A. Assign each panel a simple and logical identifying code. The coding system shall be subject to approval and shall be determined at the job site.
- B. Visually inspect the geomembrane during deployment for imperfections and mark faulty or suspect areas.
- C. Deployment of geomembrane panels shall be performed in a manner that will comply with the following guidelines:

1. Unroll geomembrane using methods that will not damage geomembrane and will protect underlying surface from damage (spreader bar, protected equipment bucket).
2. Place ballast (commonly sandbags) on geomembrane which will not damage geomembrane to prevent wind uplift.
3. Personnel walking on geomembrane shall not engage in activities or wear shoes that could damage it. Smoking will not be permitted on the geomembrane.
4. Do not allow heavy vehicular traffic directly on geomembrane. Rubber-tired ATV's and trucks are acceptable if wheel contact is less than 6 psi.
5. Protect geomembrane in areas of heavy traffic by placing protective cover over the geomembrane.

D. Sufficient material (slack) shall be provided to allow for thermal expansion and contraction of the material.

1.08 FIELD SEAMING

A. Seaming shall consist of a 12-inch overlap between adjacent panels and immediately covered with ballast (sand bags or approved equivalent) with no welding.

Table 1.1: Minimum Values for Smooth Black-Surfaced HDPE Geomembranes

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE				
Product Code			HDE 030A000	HDE 040A000	HDE 060A000	HDE 080A000	HDE 100A000
Thickness, (minimum average) mil (mm)	ASTM D 5199	every roll	30 (0.75)	40 (1.00)	60 (1.50)	80 (2.00)	100 (2.50)
Lowest individual reading (-10%)			27 (0.69)	36 (0.91)	54 (1.40)	72 (1.80)	90 (2.30)
Density, g/cm ³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94	0.94
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb					
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		114 (20)	152 (27)	228 (40)	304 (53)	380 (67)
Strength at Yield, lb/in-width (N/mm)			63 (11)	84 (15)	126 (22)	168 (29)	210 (37)
Elongation at Break, %	G.L. 2.0 in (51 mm)		700	700	700	700	700
Elongation at Yield, %	G.L. 1.3 in (33 mm)		12	12	12	12	12
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	21 (93)	28 (125)	42 (187)	56 (249)	70 (311)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	54 (240)	72 (320)	108 (480)	144 (640)	180 (800)
Carbon Black Content, %	ASTM D 1603	20,000 lb	2.0	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1	+Note 1
Notched Constant Tensile Load, hr	ASTM D 5397, Appendix	200,000 lb	300	300	300	300	300
REFERENCE PROPERTY	TEST METHOD	FREQUENCY	NOMINAL VALUE				
Oxidative Induction Time, min	ASTM D 3895, 200° C; O ₂ , 1 atm	200,000 lb	>100	>100	>100	>100	>100
Roll Length ⁽¹⁾ (approximate), ft (m)			1,120 (341)	870 (265)	560 (171)	430 (131)	340 (104)
Roll Width ⁽¹⁾ , ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft ² (m ²)			25,200 (2,341)	19,575 (1,819)	12,600 (1,171)	9,675 (899)	7,650 (711)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE HD is available in rolls weighing about 3,900 lb (1,769 kg)
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and ITB of <-77° C when tested with ASTM D 746.
- ⁽¹⁾Roll lengths and widths have a tolerance of ± 1%.

PART 2: PRODUCTS

2.01 HIGH DENSITY POLYETHYLENE LINER (HDPE)

- A. Contractor shall use Smooth Black-Surfaced 40 mil HDPE.

PART 3: EXECUTION

3.01 QUALITY ASSURANCE

- A. The RRC Authorized Representative shall examine the geomembrane rolls upon delivery to the site and report any deviations from project specifications to the contractor.
- B. The RRC Authorized Representative may decide to arrange conformance testing of the rolls delivered to the job site. For this purpose, the engineer shall take a sample three feet (along roll length) by roll width according to ASTM Practice D4354. The sample shall be properly marked, wrapped and sent to an independent laboratory for conformance testing.
- C. The pass or fail of the conformance test results shall be determined according to ASTM Practice D 4759.

3.02 INSTALLATION

- A. The geomembrane shall be handled in such a manner as to ensure that it is not damaged in any way. Should the contractor damage the geomembrane to the extent that it is no longer usable as determined by these specifications or by the RRC Authorized Representative, the contractor shall replace the geomembrane at his own cost.
- B. The geomembrane shall be installed to the lines and grades as shown on the contract drawings and as described herein.
- C. The geomembrane shall be rolled down the slope in such a manner as to continuously keep the geomembrane in tension by self weight. The geomembrane shall be securely anchored in an anchor trench as shown on the contract drawings.
- D. In the presence of wind, all geomembrane shall be weighted by sandbags or approved equivalent. Such anchors shall be installed during placement and shall remain in place until replaced with cover material.
- E. The contractor shall take necessary precautions to prevent damage to adjacent or underlying materials during placement of the geomembrane. Should damage to such material occur due to the fault of the contractor, the latter shall repair the damaged materials at his own cost and to the satisfaction of the RRC Authorized Representative.

- F. The geomembrane shall not be exposed to precipitation prior to being installed and shall not be exposed to direct Sun light for more than 15 days after installation.
- G. Adjacent geomembrane panels shall be attached by a 12-inch overlap with no welding.
- H. The contractor shall not use heavy equipment to traffic above the geomembrane without approved protection.
- I. The geomembrane shall be covered as soon as possible after installation and approval. Installed geomembrane shall not be left exposed for more than 15 days.
- J. Material overlying the geomembrane shall be carefully placed to avoid wrinkling or damage to the geomembrane.

END OF SECTION

SECTION 02350
RECOVERY SUMP INSTALLATION

PART 1. GENERAL

1.01 SCOPE

The installation of two (2) PVC cased groundwater recovery sumps and two (2) PVC cased observation wells.

1.02 SUBMITTALS

The Contractor shall provide documentation from the manufacturer verifying material obtained.

PART 2. PRODUCTS

2.01 MATERIALS

A. All PVC addressed in this section shall conform to ASTM F480-88A. Solvent cement shall not be used.

B. The sump casing shall be 12" schedule 40 PVC.

C. The sump screen shall be 12" 0.020-inch machine slot schedule 40 PVC.

D. The sump end slip cap shall be 12" PVC.

E. The observation well casing shall be 12" schedule 40 PVC.

F. The observation well screen shall be 12" 0.020-inch machine slot schedule 40 PVC.

G. The observation well end slip cap shall be 12" PVC.

PART 3. EXECUTION

3.01 SUMP INSTALLATION

A. The sumps shall be installed to a depth of approximately 12 feet below ground surface (bgs). See drawing C-101 for details of sump construction.

B. The sumps shall consist of 12-inch Schedule 40 PVC pipe with 0.020-inch machine slot from 1 ft below HDPE liner to 1 ft above bottom cap.

C. The sumps shall be capped as shown on the Drawings.

3.02 OBSERVATION WELL INSTALLATION

- A. The observations wells shall be installed to a depth of approximately 9 feet below ground surface (bgs). See drawing C-101 for details of well construction.
- B. The observations wells shall consist of 12-inch Schedule 40 PVC pipe with 0.020-inch machine slot from 1 ft below HDPE liner to the bottom cap.
- C. The observation wells shall be capped as shown on the Drawings.

END OF SECTION

SECTION 02355
RECOVERY TRENCH BACKFILL PLACEMENT

PART 1. GENERAL

1.01 SCOPE

- A. Placement of filter pack in the recovery trench.
- B. Placement of select granular fill in the recovery trench.

1.02 SUBMITTALS

- A. The Contractor shall submit to the RRC sample and grain size distribution curves for the filter pack at least 2 weeks prior to commencing placement.
- B. The Contractor shall submit to the RRC a sample, and physical properties of the select granular fill materials, including grain size analysis, at least two weeks prior to placement.

PART 2. PRODUCTS

2.01 MATERIALS

- A. The filter pack shall consist of commercially available 20/40-grade washed silica sand. Use of 16/30-grade washed silica sand is an acceptable alternative.
- B. The select granular fill shall be similar in grain size distribution to the adjacent native material. Excavated material from the unsaturated zone may be used in place of the select granular fill pending the absence of foreign debris and clasts greater than 1/2-inch in diameter.

PART 3. EXECUTION

3.01 METHOD

- A. The filter pack shall be placed starting at the bottom of the trench and progressing upward vertically in the trench. The filter pack shall be placed around the extraction sumps and observation wells that have been put into place prior to filter pack placement. This procedure shall be repeated horizontally in the trench until the trench is filled to the required elevation. Extraction sumps and observation wells shall be maintained in a vertical position equidistant between the walls of the trench.
- B. The select granular fill shall be placed and compacted mechanically to an unyielding surface following installation of HDPE liner. The Contractor shall mechanically compact soil to a non-yielding surface without damaging the HDPE liner.

OSHA Trench Safety regulations shall be complied with at all times during compaction activities.

END OF SECTION

SECTION 02360
BIOPOLYMER SLURRY DEGRADATION AND TRENCH DEVELOPMENT

PART 1. GENERAL

1.01 SCOPE

A. After completion of backfilling the recovery trench with filter pack, the slurry shall be degraded to water and residual material and flushed from the trench. Flushed materials shall be disposed of at the direction of the Railroad Commission of Texas (RRC) Authorized Representative.

B. After biopolymer is degraded the trench shall be developed.

1.02. SUBMITTALS

A. MSDS for Rantec LEB-4 or approved equivalent.

B. Technical Data for Rantec LEB-4 or approved equivalent.

PART 2. PRODUCTS

A. Rantec LEB-4 Liquid enzyme breaker or equivalent.

PART 3. EXECUTION

3.01 METHOD

A. After the trench backfilling procedures are completed the biopolymer is to be degraded to restore hydraulic properties to the trench.

B. Rantec LEB-4, a liquid enzyme breaker, or equivalent, is to be used to rapidly breakdown the biopolymer slurry. The enzyme breaker is to be mixed at the concentrations specified by the manufacturer for the specific site conditions. The water used in this process shall be of the same quality required in Section 02310 "Biodegradable Bio-Polymer Slurry."

C. The breaker mixture shall be circulated through the trench in such a manner to break the bio-polymer slurry and to develop the trench by flowing through the recovery wells. The slurry manufacturer should be consulted in the best methodology for breaking the slurry. Generally, a staged effort is most effective, first decreasing the pH to prepare the substrate for the enzyme action, then a dose of enzymes to clear out around the well screens, then alternating injection and extraction of enzyme treated waters.

D. Water should be treated and flushed through the trench until the biopolymer is sufficiently degraded and trench and sumps are properly developed. Trench and sumps are considered developed when there is substantially no visible turbidity in the extracted water (i.e. less than 5 nephelometric turbidity units (NTUs)).

E. Residual materials and water used for flushing shall be disposed of on-site or at a facility permitted to accept such waste. On-site disposal shall only be permitted if materials and water meets acceptable criteria approved by the RRC.

END OF SECTION

SECTION 02610
WATER LINE CONSTRUCTION

PART 1. GENERAL

1.01 SCOPE

A. The Contractor shall furnish all materials, labor, and equipment for constructing 2-inch PVC water lines and associated equipment, as detailed on the plans.

1.02 SUBMITTALS

A. Pipe: The Contractor shall submit descriptive information and evidence that the materials and equipment the Contractor proposes for incorporation into the Work are of the kind and quality that satisfies the specified functions and quality.

1.03 MATERIALS

A. The Contractor shall furnish and place materials meeting the requirements of these specifications, of the dimensions and types at the locations and elevations shown on the plans or established by the Railroad Commission of Texas (RRC) Authorized Representative. All materials shall be approved by the RRC Authorized Representative before being installed and any of these materials placed before they are so approved shall be removed and replaced with approved materials.

1.04 STORAGE OF MATERIALS

A. Materials delivered to the site of the work prior to their use shall be stored so as to prevent damage or deterioration, and in a manner satisfactory to the RRC.

1.05 PIPE HANDLING

A. Proper implements, tools, and facilities shall be provided and used by the Contractor for the safe and convenient prosecution of the work. All pipe, fittings, and valves shall be carefully lowered into the trench piece by piece by means of suitable tools or equipment in such a manner as to prevent damage to pipe. Under no circumstances shall pipe or accessories be dropped into the trench.

B. At all times when pipe laying is not in progress, the open ends of the pipe shall be closed by approved means. No trench water shall be permitted to enter the pipe. All foreign matter or dirt shall be removed from the pipe, and it shall be kept clean by approved means during and after laying. No pipe shall be laid in water or when trench conditions are unsuitable for such work.

C. Cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat workmanlike manner without damage to the pipe.

PART 2. PRODUCTS

2.01 PVC PIPE

A. All PVC Schedule 40 pipe shall be manufactured from a Type I, Grade I Polyvinyl Chloride (PVC) compound with a Cell Classification of 12454 per ASTM D1784. The pipe shall be manufactured in strict compliance to ASTM D1785 and D2665 (where applicable), consistently meeting and/or exceeding the Quality Assurance test requirements of these standards with regard to material, workmanship, burst pressure, flattening, and extrusion quality. The pipe shall be manufactured in the USA, using domestic materials, by an ISO 9001 certified manufacturer. All pipe shall be stored indoors after production at the manufacturing site until shipped from factory. This pipe shall carry the National Sanitation Foundation (NSF) seal of approval for potable water applications.

B. Pipe and fittings for water lines shall be designed to withstand minimum internal working pressures of one hundred forty (140) pounds per square inch unless otherwise noted on the plans or in the bid proposal.

2.02 PIPING BACKFILL MATERIAL

A. Sand and granular backfill material will be used for the initial backfill operation to a point six (6") inches above the top of the pipe. Backfilling above this layer shall be done with good sound earth. Broken concrete, rock, bituminous pavement, or other lumpy material shall not be used in the backfill except as the lumps are small and their dispersal in the backfill is made in the upper section in a manner satisfactory to the RRC Authorized Representative. Materials of a perishable, spongy, or otherwise improper nature shall not be used in backfilling. No backfill shall be made until it is authorized by the RRC Authorized Representative. Granular backfill shall be free of clasts larger than ½-inch in diameter. Sand shall be readily available play sand or approved equivalent. All debris shall be removed. Sheeting, shoring and bracing, if used, shall be pulled and removed during the progress of the backfilling in a manner satisfactory to the RRC Authorized Representative.

B. On water line construction when, in the opinion of the RRC Authorized Representative, the subgrade material encountered at grade is soft, spongy, and unsuitable, it shall be removed to such a depth that the replacement thereof with firmly tamped gravel will provide an unyielding, stable foundation. The gravel used in cushion or backfill shall be pit run gravel or crushed stone and shall be free from silt, loam, or vegetable matter and shall be of a gradation suitable to the RRC Authorized Representative.

C. Subgrades that have been allowed to become unstable by neglect of the Contractor, by improper drainage or lack of drainage, and when in the opinion of the RRC Authorized Representative, the condition was caused by the neglect or fault of the Contractor, the RRC Authorized Representative shall order the Contractor to remove the unstable subgrade and replace the same with gravel at the expense of the Contractor, and no extra compensation will be allowed.

2.03 BALL VALVES

A. In general, all ball valves shall be Schedule 40 or Schedule 80 PVC, ¼ turn t-handle operated with double-union end body design.

B. Valves must embody the best workmanship and finish, and open and close freely and easily. Valves shall be tested at a hydrostatic pressure of 300 pounds per square inch, and shall be guaranteed for 150 pounds water working pressure.

PART 3. EXECUTION

3.01 PROTECTION OF TREES, PLANTS, SHRUBBERY, ETC.

Where trees, plants, shrubbery, etc., are adjacent to the line of the work and are not to be removed or removed and replaced, the Contractor shall protect such trees, plants, shrubbery, etc., and shall not permit machinery or employees to scrape, tear the limbs from or damage or attach guy cables to them and if such trees, plants, shrubbery, etc. would be damaged by machinery, etc., hand excavation may be required. The Contractor shall be responsible for all damages to adjacent trees, plants, shrubbery, etc.

3.02 CONSTRUCTION METHODS

A. Trenches shall be excavated by trenching machine or backhoe, except in locations where hand trenching is required. The banks of trenches shall be vertical, to a point one (1) foot above the top of the pipe.

B. Trenches will be excavated to the lines and grades as shown on the plans. No change in locations of the lines is contemplated, but should any changes be made in the lines not materially altering the amount or character of the trenching to be done, the Contractor shall proceed with the changed alignment at the bid price.

C. The width of the trench shall be six (6) inches minimum and twelve (12) inches maximum on each side of the pipe.

D. Trenches for water pipe shall be of such depth as to provide a minimum of 18" of cover unless otherwise shown on the plans. Trenches for conduit pipe shall be of such depth as to provide a minimum of 24" of cover unless otherwise shown on the plans.

E. Pipe shall be laid in all trenches that have been opened by the end of each day's work.

F. If the bottom of the trench becomes an unstable foundation for the pipe through the neglect of the Contractor to adequately shore or dewater, the Contractor will be required to remove the unstable material and backfill the trench to the proper grade with approved compacted gravel, and no extra compensation will be granted for this material or work.

G. After inspection of pipe lines has been finished on any completed portion of the work the trench may be backfilled. Backfilling shall be accomplished in compliance with the applicable portions of these specifications.

H. Drop pipe within the sumps shall be of a single piece. No joints are permitted in the drop pipe.

3.03 SHORING AND BRACING

If required due to sloughing or movement of the banks, the Contractor shall brace the sides of the trench to maintain the excavation clear of obstructions that will in any way hinder or delay the progress of the work. Shoring and bracing shall be considered as incidental work and will be included in the contract prices for the various units of measure.

3.04 GROUND/SURFACE WATER HANDLING

The Contractor shall immediately remove all surface or seepage water which may accumulate during the excavation and construction work by pumping, bailing or draining. The Contractor shall have available at all times sufficient equipment in proper working order for doing the work herein required. All water removed from excavations shall be disposed of in an approved manner. Pumping, bailing, draining, etc. shall be considered as incidental work and will not be bid for as separate items but their cost shall be included in the contract prices for the various units of measure.

3.05 DISPOSAL OF EXCAVATED MATERIALS

Excavated materials, so far as needed and of a suitable character, shall be piled adjacent to the work to be used for backfilling as required. Excavated materials unsuitable for the backfilling or in excess of that required for backfilling shall be disposed of on-site per the direction of the RRC Authorized Representative.

3.06 PROTECTION OF UNFINISHED WORK

Before leaving work for the night, during a storm, or at other times, care must be taken to protect and securely close the unfinished end of the pipe. Any earth or other materials that may find entrance into the pipe through any such open or unplugged end of the pipe must be removed at the Contractor's expense.

3.07 PIPE LAYING

A. Pipe shall be laid in a straight line in the trench with no kinks or curves with a constant slope towards the equipment shed. Pipe shall not be laid in such a manner that results in low points for water/sediment collection within the pipe.

3.08 PIPE JOINTS

A. Joints for PVC water pipe shall be solvent cemented. Cement shall not be thinned. Cement that has thickened shall be discarded. Cement shall not be used beyond its shelf life and shall not be subject to temperatures below thirty (30) degrees Fahrenheit.

B. Piping shall be cut square with a saw or pipe cutter designed especially for plastic pipe.

Pipe and fittings shall be protected from serrated holding devices or abrasions.

C. Burrs shall be removed from both inside and outside of the pipe. Dust, dirt and moisture shall be removed from the surfaces that shall be cemented.

D. Solvent chemical cleaner recommended by the company whose product is being installed shall be applied inside the fitting and on the outside of the piping shall be joined.

E. A paint brush shall be used to apply the solvent cement in a moderate, even coating in the fitting socket as well as covering the pipe on the joining surfaces.

F. Joints shall be assembled as quickly as possible before the cement dries. Insert the piping into the fitting socket turning the pipe slightly to ensure even distribution to the cement. Hold the piping in a firm position so it does not "back out" of the joint.

G. Remove excess solvent cement from the exterior of the joint with a clean dry cloth. The joint shall not be handled for a two (2) minute period. A fifteen (15) minute period shall be allowed for the joint to develop hanging strength.

H. A Cemented pipe joint shall not be made in conditions of excessive moisture (ninety (90) percent humidity level) or when the temperature is below forty (40) degrees or above ninety (90) degrees Fahrenheit.

3.09 BACKFILL

A. General

1. Excavation shall be backfilled only with approved materials. The placing of backfill material shall not begin until approval has been given by the RRC Authorized Representative and shall be done immediately when so ordered by the RRC Authorized Representative.

2. Backfilling shall be brought up to an elevation slightly above the original ground level to allow for subsequent settlement. The top surface or slopes of all backfill shall be neatly graded off in a workmanlike manner, and where select topsoil, sod, or other material is removed and piled separately, such material shall be carefully replaced in a manner satisfactory to the RRC Authorized Representative.

B. Initial Backfill - After the pipe has been laid the pipe lines shall be backfilled with sand to a height of six (6") inches over the top of the pipe. Sand shall be readily available play sand or approved equivalent. To insure a good firm bedding the backfill shall be cut under and around the pipe with shovels up to the spring line of the pipe. This backfill shall be done so as not to displace the pipe from its original position.

C. Final Backfill - The final backfilling operation shall be made from the spoil bank, free from clods or lumps exceeding 6" in any dimension, placed in uniformly compacted layers not exceeding one (1') foot in loose depth and hand or mechanically tamped in a manner approved by the RRC Authorized Representative. Backfill shall be compacted to a non-yielding surface.

D. Prior to completion and final acceptance of the entire job, the Contractor will be required to refill and recrown all trenches which have settled below ground level or where the crown is reduced to indicate that such subsidence will occur.

3.10 HYDROSTATIC TEST

A. After the pipe has been laid and backfilled each valved section of newly laid pipe shall be subjected to a hydrostatic pressure test. For any section being tested the pressure applied shall be such that at the highest point in the section the pressure shall be 127.5 pounds per square inch. Adjustment as required shall be made for differential in elevation between the low point of the section being tested and the centerline of the pressure test gauge. The maximum pressure shall be 180 psi at the lowest point.

B. Each valved section of pipe shall be slowly filled with water, and the specified test pressure measured to the point of lowest elevation, shall be supplied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection, and all necessary apparatus including gauges and meters shall be furnished by the Contractor.

C. The duration of each pressure test shall be four (4) hours. Before applying the specified test pressure all air shall be expelled from the pipe. To accomplish this taps shall be made, if necessary, at the points of highest elevation and afterwards tightly plugged. At intervals during the test the entire route of the pipe line shall be inspected to locate any leaks or breaks. Any defective joints, cracked or defective pipe, fittings, or valves discovered in consequence of this pressure test shall be removed and replaced with sound material in the manner provided, and the test shall be repeated until satisfactory results are obtained.

D. No pipe installation will be accepted until the leakage is less than a rate equal to twenty (20) gallons per inch of nominal diameter of pipe line per mile over a twenty-four (24) hour period for PVC pipe.

E. Should any test of pipe in place disclose leakage greater than that specified, the Contractor shall at his own expense locate and repair the defective joints until the leakage is within the specified allowance.

F. Leakage is defined as the quantity of water supplied into the newly laid pipe, or any valved section of it, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

3.11 CLEAN-UP

During construction the Contractor shall maintain the premises in an orderly, neat, and presentable manner. Scraps and debris shall not be left scattered but shall be assembled together and such as are unusable shall be moved from the premises or disposed of to the satisfaction of the RRC Authorized Representative. When construction of the contract has been otherwise completed, the Contractor shall remove all left over construction materials, equipment, scraps, debris, and

rubbish. Earthwork shall be smoothed and graded to the lines shown on the plans. Backfill over all trenches shall be left in a uniform and neat condition.

END OF SECTION

SECTION 02700
SITE MAINTENANCE

PART 1. GENERAL

1.01 GENERAL

A. All cleaning and disposal operations shall comply with applicable codes, ordinances, regulations, and environmental laws.

PART 2. PRODUCTS

2.01 MATERIALS

A. The Contractor shall only use those cleaning materials and methods that will not create hazards to health or environment.

PART 3. EXECUTION

3.01 DURING CONSTRUCTION

A. The Contractor shall clean the site and adjacent areas daily to collect contaminated waste material, debris, refuse and rubbish resulting from site activities. Such material will be placed in proper containers, provided by the Contractor, at staging and storage areas for disposal.

3.02 AFTER CONSTRUCTION

A. The Contractor shall inspect all work areas and certify in a report to RRC that the site and adjacent areas are free of all waste materials, rubbish, and debris generated by site activities.

3.03 MEASUREMENT AND PAYMENT

A. There will be no separate payment for this item and it shall be considered subsidiary to normal daily Contractor operations.

END OF SECTION

SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1. GENERAL

1.01 SUMMARY

A. This Section includes cast-in-place concrete, including reinforcement, concrete materials, mix design, placement procedures, and finishes.

1.02 SUBMITTALS

A. Product Data: For each manufactured material and product indicated.

B. Design Mixes: For each concrete mix indicated.

C. Shop Drawings: Include details of steel reinforcement placement including material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports.

D. Material certificates.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

B. Comply with ACI 301, "Specification for Structural Concrete," including the following, unless modified by the requirements of the Contract Documents.

1. General requirements, including submittals, quality assurance, acceptance of structure, and protection of in-place concrete.
2. Formwork and form accessories.
3. Steel reinforcement and supports.
4. Concrete mixtures.
5. Handling, placing, and constructing concrete.

PART 2. PRODUCTS

2.01 MATERIALS

A. Formwork: Furnish formwork and form accessories according to ACI 301.

B. Steel Reinforcement:

1. Reinforcing Bars: ASTM A 615/A 615M, **Grade 60**, deformed.
 2. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- C. Concrete Materials:
1. Portland Cement: ASTM C 150, Type I.
 2. Normal-Weight Aggregate: ASTM C 33, uniformly graded, not exceeding 1-1/2-inch nominal size.
 3. Water: Complying with ASTM C 94.
- D. Admixtures:
1. Air-Entraining Admixture: ASTM C 260.
- E. Vapor Retarder: Multi-ply reinforced polyethylene sheet, ASTM E 1745, Class C, not less than 7.8 mils thick; or polyethylene sheet, ASTM D 4397, not less than 10 mils thick.
- F. Curing Materials:
1. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
 2. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf.
 3. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
 4. Water: Potable.
 5. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

2.02 CONCRETE MIXES

- A. Comply with ACI 301 requirements for concrete mixtures.
- B. Prepare design mixes, proportioned according to ACI 301, for normal-weight concrete determined by either laboratory trial mix or field test data bases, as follows:
1. Compressive Strength (28 Days): 3000 psi.
 2. Slump: 4 inches.
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 2.5 to 4.5 percent.
1. Air content of trowel-finished interior concrete floors shall not exceed 3.0 percent.

2.03 CONCRETE MIXING

- A. Ready-Mixed Concrete: Comply with ASTM C 94.
1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.

C. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3. EXECUTION

3.01 INSTALLATION, GENERAL

A. Formwork: Design, construct, erect, shore, brace, and maintain formwork according to ACI 301.

B. Vapor Retarder: Install, protect, and repair vapor-retarder sheets according to ASTM E 1643; place sheets in position with longest dimension parallel with direction of pour.

1. Lap joints 6 inches and seal with manufacturer's recommended tape.

C. Steel Reinforcement: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

D. Tolerances: Comply with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

3.02 CONCRETE PLACEMENT

A. Comply with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.

B. Do not add water to concrete during delivery, at Project site, or during placement.

C. Consolidate concrete with mechanical vibrating equipment.

3.03 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4 inch in height rubbed down or chipped off.

B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.04 FINISHING UNFORMED SURFACES

A. General: Comply with ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Screed surfaces with a straightedge and strike off. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess moisture or bleedwater appears on the surface.

1. Do not further disturb surfaces before starting finishing operations.

C. Float Finish: Apply float finish to slab surfaces.

3.05 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection, and follow recommendations in ACI 305R for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions occur before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.

D. Cure formed and unformed concrete for at least seven days as follows:

1. Moisture Curing: Keep surfaces continuously moist with absorptive cover, water saturated and kept continuously wet.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

END OF SECTION

SECTION 10100
PREFABRICATED EQUIPMENT SHED

PART 1. GENERAL

1.01 SCOPE

A. The Contractor shall furnish and install one (1) 10' x 10' (nominal) pre-engineered, prefabricated equipment shed, per the Drawings.

PART 2. PRODUCTS

2.01 EQUIPMENT SHED

A. The equipment shed shall be pre-engineered and prefabricated to allow for immediate installation on-site.

B. The shed dimensions shall be sufficient to allow for installation of all equipment, plumbing and electrical service required for the project, with sufficient room for easy access and maintenance. The interior ceiling height shall be no less than 6'.

C. The shed shall be constructed of steel and the interior and exterior surfaces shall be coated to prevent rust.

D. The shed shall be waterproofed and insulated to protect equipment. Insulation may be retrofitted to prefabricated structure but shall have a minimum insulation value of R-10. All penetrations shall be sealed.

E. The shed shall be lighted, heated and two electrical receptacles shall be provided. See Electrical Plans and Specifications.

E. The door shall be configured such that it may be locked and secured. The Contractor shall furnish all locks and keys.

F. The equipment shed shall be anchored to the foundation slab per manufacturer's instructions.

2.02 SUBMITTALS

A. The Contractor shall submit shop drawings of sufficient detail to ensure compliance with the provisions of the drawings and specifications. Shop drawings shall clearly show all dimensions, and manufacturer's information.

PART 3. EXECUTION

3.01 INSTALLATION

A. Upon approval of the proposed equipment shed by the Railroad Commission of Texas (RRC) Authorized Representative, the Contractor shall locate and complete installation of the concrete foundation slab per the drawings and Section 03300, "Cast-In-Place Concrete."

B. The Contractor shall install the equipment shed and anchor it to the foundation per the manufacturer's instructions.

C. Contractor shall provide and install waterproofing and insulation as necessary per manufacturer's instructions.

D. Contractor shall install and connect power, lighting and heating per Electrical Plans and Specifications.

E. Contractor shall make plumbing penetrations and install pump, air compressor and associated equipment within shed.

F. All penetrations shall be sealed and insulated.

END OF SECTION

SECTION 11210
PUMP INSTALLATION

PART 1. GENERAL

1.01 SCOPE

A. These specifications are for the installation of a double diaphragm pump, air compressor, and associated equipment as shown in the plans.

B. The Contractor shall furnish all materials, labor, and equipment for constructing the work included in these specifications and as detailed on the plans.

1.02 PROTECTION OF WORK

The Contractor will be held responsible for the care of all work until final completion and acceptance, and he will be required to make good, at his own expense, any damage or injury it may sustain for any cause. He shall assume all risks from floods and casualties of every description and make no charge for damages from such cause.

1.03 STORAGE OF MATERIALS

Materials delivered to the site prior to their use shall be stored so as to cause the least inconvenience to the public and in a manner satisfactory to the Railroad Commission of Texas (RRC) Authorized Representative. Both the pump and air compressor shall be sheltered from the elements at all times.

1.04 SUBMITTAL DATA

A. Submit sufficient descriptive literature to demonstrate compliance with these specifications.

B. Submit pump curves defining full range of pump performance, efficiency, and horsepower.

C. Submit manufacturer's descriptive literature; catalog cuts, and installation and operation manuals.

PART 2. PRODUCTS

2.01 MATERIALS

A. Pump: Double Diaphragm Original Series Plastic Pump Model P1, order number P1/PPPPP/BNS/BN/KBN, as manufactured by Wilden Pump & Engineering Company, or approved equivalent. The pump shall have polypropylene wetted parts & outer piston, polypropylene center

section, polypropylene air valve, buna-n diaphragms, buna-n valve balls, PVDF valve seat, and buna-n valve seat o-rings. The pump shall be capable of a steady state pumping at a rate of 1.5 gallons per minute (gpm) or 50 barrels per day (bbl/day).

B. Air Compressor: Ingersoll Rand electric driven single stage air compressor (model number SS3L3) or approved equivalent with 60 gallon vertical pressure tank, 135 psi maximum, 3/8" NPT outlet, 3 hp, 230 volts, and single phase.

C. Pressure Gauge: Ashcroft Stainless Steel, Model 35/1009/04L/LL/60 psi, or approved equivalent.

D. Flow Meter: Epoxy coated bronze multijet impeller 1-inch flow meter, model DLJ100, as manufactured by Daniel L. Jerman Co., or approved equivalent.

E. Switches for operating air compressor solenoid shall be float type, series LS-800 as manufactured by Gems Sensors, or approved equivalent. Switches shall be sized as appropriate for location of installation.

F. The connection of the air compressor and pump shall include a manual air shut of valve, combination filter and regulator, needle valve, and electrical solenoid as shown on the drawings.

PART 3. EXECUTION

3.01 INSTALLATION

A. The Contractor shall furnish and place materials meeting the requirements of these specifications, of the dimensions and types at the locations and elevations shown on the plans or established by the RRC Authorized Representative. All materials shall be approved by the RRC Authorized Representative before being installed and any of these materials placed before they are so approved shall be removed and replaced with approved materials.

B. Installation of the pump shall follow the manufacturer's installation guide located in the Engineering Operation & Maintenance Manual and as depicted on the plans. Installation of the air compressor shall conform to the manufacturers suggested instructions.

C. The pump and air compressor shall be directly secured to the concrete slab.

D. The pump, air compressor, and associated fittings shall be installed such that daily operation, maintenance, and repair are not inhibited.

E. Pipe penetrations into equipment shed shall be no less than 6-inches from top of concrete slab. No penetrations shall exist through the concrete slab.

END OF SECTION

SECTION 13210
WATER STORAGE TANKS

PART 1. GENERAL

1.01 SCOPE

A. The Contractor shall furnish and install two (2) API 12P standard fiberglass tanks with API standard fittings as shown on the contract drawings.

1.02 QUALITY ASSURANCE

A. The tank shall be supplied by a manufacturer who specializes in oilfield fiberglass tank fabrication and erection (i.e. Permian Tank Company or approved equivalent).

B. Upon completion of the tanks, provide the RRC Authorized Representative with a written certification that the tank has been designed, fabricated, and erected in accordance with the manufacturer's recommendations and with the requirements of API 12P standard.

PART 2. PRODUCTS

2.01 TANKS

A. The tanks shall be shop fabricated fiberglass, of 500 barrel capacity each.

B. The tanks shall be compliant with API 12P standards for above ground tanks including but not confined to the following.

1. One 4-inch Primary Vent
2. One 4-inch Fill Line
3. One 4-inch Auxiliary Vent
4. One 8-inch Thief Hatch
5. Two 4-inch Overflow Lines
6. One 24-inch Manway Hatch
7. One 4-inch Pipeline Connection
8. One 4-inch Drain Line

C. A carbon veil shall be installed during the fabrication of the tanks for grounding.

D. Overflow lines shall connect the top of the tanks.

E. Pipeline connections shall protrude beyond the containment berm and connect at a tee. Contractor shall include all valves and fittings as shown on the contract drawings.

F. Tanks, stairways, and walkways shall be properly grounded.

G. API monogram on tanks are not required.

H. The level float switch shall be placed in the 4-inch Auxiliary Vent of the tank nearest the equipment shed.

I. Recovered water shall enter both tanks through the 4-inch Fill Line via 4-inch to 2-inch bushing or approved equivalent.

2.02 SUBMITTALS

A. The Contractor shall submit shop drawings of sufficient detail to ensure compliance with the provisions of the drawings and specifications. Shop drawings shall clearly show all connections, dimensions, stairways, walkways, and manufacturer's information.

PART 3. EXECUTION

3.01 INSTALLATION

A. Subgrade: Prior to installation of tanks, a pad of pea gravel base shall be set and compacted sufficient to provide a solid, level base for the tanks. Pea gravel shall be readily available and consist of similar size and shape found in oil field applications. There are no specific grading requirements for pea gravel such that it provides adequate support for the life of the tank battery. The pea gravel shall be placed in a 5-inch thick grade band, or approved equivalent that is equal to the diameter of the tank. The pea gravel shall be leveled, compacted, and ready for tank placement prior to tank arrival at the Site.

B. Tanks: The tank manufacturer shall deliver and set the tanks on each pad and install all stairways and walkways.

C. Plumbing: The Contractor shall install all plumbing and level float switches associated with the tank battery as shown on the contract drawings.

D. Grounding: The Contractor shall properly ground the tanks using the ½-inch stainless steel grounding bolt located near the pipeline connection. The Contractor shall install grounding rod or wire to a depth approved by an approved oilfield electrician.

END OF SECTION

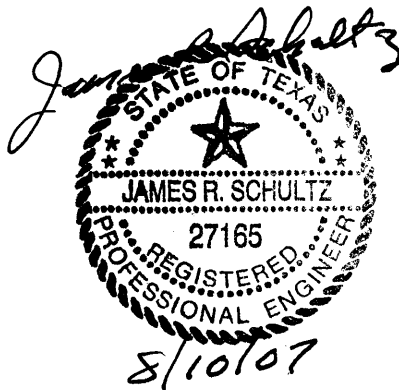
**ELECTRICAL/INSTRUMENTATION
SPECIFICATIONS**

For

**West O'Daniel Seep
Howard County, Texas**

Prepared By:

James R. Schultz, P.E.



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SECTION 16010
ELECTRICAL GENERAL INFORMATION

PART 1: GENERAL

1.01 SCOPE OF WORK

- A The work included under this Section consists of the furnishing of all labor, equipment, supplies and materials, and the performing of all operations necessary to complete the installation of an electrical system for light, power, instrumentation, controls and grounding as indicated on the plans, including electrical outlets and connections shown or required for all motors and equipment furnished under other sections of the work together with local control and remote control wiring. The work includes, but is not limited to, trenches, copper wire, conduit, fittings, outlet boxes, junction boxes, pull boxes, switches, receptacles, lighting fixtures, lamps, relays, timers, alarms, instruments, control devices and control panel.
- B This section shall apply to all sections covered in Division 16.
- C. All submittals and questions, etc. pertaining to this project shall be transmitted directly to the Texas Railroad Commission (RRC) who will forward them to the Engineer for review, answers, etc. The Engineer will then respond to the RRC with a copy to the Contractor.

1.02 RELATED WORK SPECIFIED ELSEWHERE

Division 1

1.03 REFERENCE STANDARDS

- A Qualifications
 - 1. Workmanship shall be of the highest quality and all work shall be done by workmen skilled in the trades involved.
 - 2. It is the intent of these plans and/or specifications to provide finished work, and any items omitted therefrom, which are clearly necessary for the completion of the work or its appurtenances, except as specifically mentioned below or on the drawings, shall be considered a portion of the work even though not directly specified. In the event of a dispute arising as to the interpretation or intent of drawings and/or specifications, the decision of the RRC shall be final.
 - 3. Prior to submitting a bid, the CONTRACTOR shall visit the site to ascertain the conditions to be met there in installing electrical work and make due provision in the bid. Submission of the bid indicates that the CONTRACTOR has covered all work necessary to properly complete the job. Failure on the part of the CONTRACTOR to comply with this requirement shall not be

considered justification for the omission or faulty installation of electrical work nor for the payment of extra compensation for the work covered by these specifications and drawings.

4. The naming of manufacturers in the specifications and/or drawings shall not be construed as eliminating the materials, products, or services of other manufacturers and suppliers having approved equivalent items. Approval of equals shall be by the RRC for each contract and shall not apply to any other contract.
5. The job is not considered complete until a set of "as built" drawings are received by the Texas Railroad Commission (RRC) from the CONTRACTOR. The CONTRACTOR shall continually update the drawings during the construction time period by marking a set of drawings with red ink to show the actual locations of underground conduit runs and any changes in the electrical installation.

B Standards and Codes

All construction, installation, workmanship, equipment and materials shall conform to all acts, laws, rules and regulations having jurisdiction in the area where this project is to be located, and to the current edition of the following standards or codes:

National Electrical Code (NEC)
National Electrical Manufacturers Association (NEMA)
American National Standards Institute (ANSI)
National Fire Protection Association (NFPA)
Illuminating Engineering Society (IES)
Insulated Power Cable Engineers Association (IPCA)
Institute of Electrical and Electronic Engineers (IEEE)
Underwriter's Laboratories (UL)
Electrical Testing Laboratory (ETL)
Anti-Friction Bearing Manufacturer's Association (AFBMA)

Codes and regulations are to be interpreted as minimum requirements and shall in no way restrict the installation.

C Allowable Tolerances

1. Scaling dimensions from drawings may be used only for approximate locations. All dimensions and locations of equipment shall be field verified with existing conditions on the job site by the CONTRACTOR.
2. Equipment locations and conduit installation shall follow the layouts shown on the drawings. These layouts, however, are diagrammatic and shall be subject to such changes as may be necessary to complete the installation, to coordinate the work with other trades, or to overcome obstacles encountered during construction.

3. The CONTRACTOR shall apply for detailed information regarding the position of equipment and outlets that are not dimensioned on the drawings. The final or required locations must be coordinated on the job site with other outlets or other trades.
4. Where a major deviation from the drawings is indicated by practical considerations, the CONTRACTOR shall submit shop drawings showing all deviations in such detail so as to clearly indicate the necessity or desirability for the change.

D Fees

All fees, permits, licenses, etc., necessary in order to complete the work of this section shall be obtained and paid by this CONTRACTOR.

1.04 SUBMITTALS

- A All submittals shall comply with the requirement of Section 01300, Submittal Procedures.
- B Additional and specific information and products shall be submitted under each section of these specifications.

1.05 SUBSTITUTIONS

- A Whenever the term "ENGINEER APPROVED EQUAL" or "APPROVED EQUAL" appears in the specifications, the CONTRACTOR has the option to submit a product or system for RRC approval that is equal in all respects to the manufacturer's products listed. All proposed substitutions shall clearly state in writing the product for which the substitution was made.
- B Any item that is proposed as a substitute shall be accompanied by blueprints and/or other data giving sizes, capacities and all other necessary information.
- C Substitutions are acceptable in the following cases:
 1. Products specified by reference standards or by description only: Any product meeting those standards.
 2. Products specified by naming one or more manufacturers with a substitution paragraph: Submit a request for substitution for any manufacturer not specifically named.
 3. Products specified by naming several manufacturers: Products of named manufacturers meeting specifications; no options, no substitutions.

4. Products specified by naming only one manufacturer: No options; no substitution allowed.

1.06 PRODUCT, DELIVERY, STORAGE AND HANDLING

All materials and equipment furnished and/or installed under this contract shall be received and adequately protected by the CONTRACTOR.

1.07 CONSTRUCTION PERIOD TESTS

All work which is required to be placed within the construction or concealed shall be carefully tested and inspected before being permanently covered up.

1.08 PRODUCT, DELIVERY, STORAGE AND HANDLING

All materials and equipment furnished and/or installed under this contract shall be received and adequately protected by the CONTRACTOR.

1.09 JOB CONDITIONS

- A It shall be the responsibility of the CONTRACTOR to make a physical survey of existing conditions pertaining to this project.
- B The drawings showing the extent and arrangement of the work of the particular trade must be used together with the drawings showing the extent and arrangement of the work of the other trades. The CONTRACTOR shall lay out his work with due consideration for the other trades and shall be responsible for calling to the attention of the RRC any interferences encountered; such interferences shall be investigated and called to the attention of the RRC before any equipment is installed and before any material is fabricated. Relocation resulting from interferences shall be made at no additional cost to the RRC.

1.10 MEASUREMENT AND PAYMENT

- A No separate or additional payment will be made for any items of work, materials, parts, equipment, supplies or related items required to perform and complete the requirements of this Section. The costs for all such items required shall be included in the lump sum bid for the Project.
- B The contract price shall include all appurtenances and equipment necessary to make the entire work complete and ready to operate.

PART 2: PRODUCTS

2.01 MATERIALS

- A All materials and equipment provided under these Specifications shall be in new and unused condition and be manufacturer's latest standard design.

- B All materials and equipment installed under this contract shall be firmly supported and secured to the structure where required.
- C All equipment shall conform to the architectural and structural limitations encountered.

2.02 ELECTRICAL SUPPORTING DEVICES

- A Miscellaneous Steel including all anchors, brackets, trapezes, bolts, nuts, washers, etc., for a rigid installation shall be furnished and installed for the support of all electrical devices, equipment, and fixtures.
- B Material shall be sized to support entire weight of object hung.
 - 1. Standard hot rolled steel structural shapes approved by the American Institute of Steel Construction (AISC).
 - 2. Metal framing - 12 gauge lipped hot-dip galvanized steel channel, "Unistrut" brand or approved equal with compatible accessories indoors and stainless steel "Unistrut" outdoors. No perforated iron straps allowed.
- C Fabrication shall be by bolting, riveting, or welding.
- D Fastening supports to structure.
 - 1. Hangers whether threaded rod, steel channel, etc., shall be fastened only to structural members and not to air ducts, pipes or water lines.
 - 2. Structural members of any kind shall not be pierced without permission by the RRC.
 - 3. Where pipe bundles or other obstructions prevent the direct suspension of a hanger, the required hanger shall be supported from a trapeze fastened to structural members on each side of the obstruction and of sufficient strength to support the load at the span encountered.
- E Fastenings
 - 1. Wood - Long wood screws or lag screws.
 - 2. Brickwork, masonry, or concrete - expansion bolt anchors or threaded metal inserts designed for the specific load capacity.
 - 3. Steel - metal screws, bolts or welding.
 - 4. No wood plugs or nailing shall be permitted.

2.03 NAMEPLATES

- A Each starter and wall-mounted disconnect above 120 volts, shall be provided with a unit nameplate, laminated plastic, with engraved white letters on black background which identifies the use of that equipment.

The nameplate will also show the manufacturer's name and location, the manufacturer's shop order number and outline drawing number, the date of manufacture and other information required by code, such as "HIGH VOLTAGE", warnings, voltage, and amperage ratings.

- B All unit equipment shall contain individual unit nameplates. Nameplates will also be provided on all individual safety switches and combination starters. The nameplate will describe the unit or equipment which is served. Each nameplate will be of suitable height to get at least three lines of 3/16-inch high engraved laminated plastic white-on-black-background letters, indicating the function or name of the equipment, as identified on the drawings.

- C All pilot lights will include laminated plastic nameplates with 3/16-inch engraved, white letters on black background indicating what has operated or in what state the controlled load is in.

- D There shall be no abbreviations on nameplates.

- E Each nameplate will be fastened to the cubicles in an appropriate location by means of solid head rivets. No stick on type nameplates or removable screws will be acceptable.

- F Nameplates shall be affixed to the following equipment where used:

1. Motor and Circuit Disconnects - all types and ratings
2. Motor Starters - all types and rating
3. Motor Control Centers
4. Panelboards
5. Control Panels
6. Pilot Lights
7. Switches
8. Controls
9. Instruments

- G Additional or specific labels shall be required in other sections of Division 16.

- A All branch circuits shall be identified at the source and destination.
- B Lighting and power feeder circuits from panelboards or motor control centers shall have wire marked and circuit identification marked either using a panelboard directory or suitable nameplate.
- C Circuit identification shall be labeled as shown on the drawings or, where not shown on the drawings labeled according to the device or system name or function.
- D Spare or unused circuits shall be considered as "SPARE".

2.05 ELECTRICAL WORK INSPECTION

The CONTRACTOR shall perform inspection of all electrical work installed. The inspection shall include as a minimum:

1. Voltage check at each device.
2. Fuse and circuit breaker size and rating for conformance with NEC, local codes and equipment requirements.
3. Grounding in conformance with NEC and local codes.
4. Phase rotation on all 3-phase devices, machines, motors and other equipment.
5. Correct identification nameplates, labels and panelboard directories.

2.06 CLEANING

- A The CONTRACTOR shall clean all electrical equipment prior to energizing.
- B Upon completion of the project, the CONTRACTOR shall leave all equipment free of dirt, scratches and broken parts.

2.07 STORAGE

- A Storage of materials shall conform with Division 1 requirements.
- B Equipment shall be protected from physical damage during storage.
- C Store all electrical equipment on wooden skids or other supporting device. Do not store electrical equipment on bare ground or leave unprotected outside.

2.08 SPARE PARTS

- A All spare parts shall be furnished in a suitable container such as a box or case, completely labeled.

- B Furnish a minimum of five (5) spare fuses for each fuse type rated 600 volts or below.
- C Furnish two (2) spare relays for each relay type rated 600 volts or below. Relays shall include control relays and time delay relays.
- D Spare part containers shall be labeled with:
 - 1. Part name
 - 2. Place installed or used
 - 3. Rating or size
- E Spare parts required in various sections of Division 16 shall also be furnished.

PART 3: EXECUTION

3.01 FIELD QUALITY CONTROL

The CONTRACTOR shall test the completed system wiring for faults, and remove any defects prior to final inspection.

3.02 PROTECTION OF COMPLETED WORK

The CONTRACTOR shall effectively protect his work, materials and equipment from damage during the construction period. All openings into any part of the conduit system, associated fixtures and equipment must be securely covered or otherwise protected. Steel conduit and other ferrous metal supplies shall be stored where they will not be exposed to corrosion.

END OF SECTION 16010

SECTION 16111
CONDUIT SYSTEMS

PART 1: GENERAL

1.01 SCOPE OF WORK

The work performed under this Section consists of providing all labor, material, tools, equipment and related items required to furnish, and install all of the following conduit systems:

1. Rigid Galvanized Steel Conduit (RGSC)
2. Liquid-tight flexible metal conduit
3. Nonmetallic rigid Polyvinyl Chloride conduit (PVC)
4. Electrical Metallic Tubing (EMT)

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A Submittals: 01300
- B Wire and Cable: Section 16120
- C Boxes and Fittings: Section 16130
- D Grounding: Section 16450

1.03 REFERENCE STANDARDS

Governing Standards

1. The National Electrical Code as adopted by the authority having jurisdiction.
2. Nonmetallic rigid PVC NEMA Standard TC-2
3. Rigid galvanized steel conduit ANSI C80.1-1971
4. U.L.

1.04 ACCEPTABLE MANUFACTURERS

- A Allied Tube and Conduit
- B Triangle
- C Wheatland

- D Carlon
- E Engineer approved equal

1.05 SUBMITTALS

- A The submittal shall comply with the requirements of Section 01300.
- B The submittal shall include but is not limited to the following:
 - 1. Conduit manufacturer's name as used on this project.
 - 2. Conduit type and technical specifications.
 - 3. Couplings and fittings.
 - 4. Complete technical description of conduit coatings where applicable.

PART 2: PRODUCTS

2.01 HEAVY WALL RIGID GALVANIZED STEEL CONDUIT (RGSC)

- A Heavy wall rigid galvanized steel conduit shall be hot dipped galvanized or electro-galvanized inside and outside.
- B Minimum size conduit shall be 3/4" trade size unless noted or shown otherwise on the drawings.
- C Couplings shall be threaded type and hot dipped galvanized inside and outside.
- D Rigid conduit connectors at outlet boxes in concrete or in dry locations shall be the concrete tight set screw type with insulated throats.
- E Rigid conduit connectors at cabinets, junction boxes, pull boxes, raceway duct, or auxiliary gutters in dry locations shall be made with lock nuts installed both inside and outside the enclosure.
- F Install insulating bushings on the ends of conduits inside enclosures for conductor protection.
- G Fittings shall be Thomas and Betts or equal.

2.02 LIQUID-TIGHT FLEXIBLE METAL CONDUIT

- A Liquid-tight flexible metal conduit shall be type "U.A." (underwriter's listed), hot dipped galvanized or electro-galvanized both inside and outside, made in one continuous length of spirally wound steel strip with uniform interlocking convolutions and include a continuous copper ground and PVC cover jacket. Provide type "O.R." (oil resistant) where destructive oils are present.
- B Minimum size flexible metal conduit shall be 3/4".
- C Liquid-tight flexible conduit connectors and fittings shall be insulated type furnished in straight or standard angles. Die cast fittings will not be allowed.
- D Fittings shall be Thomas and Betts or equal.
- E Flexible non-metallic liquid-tight conduit or tubing shall not be used.
- F Maximum length shall be 3 feet.

2.03 ELECTRICAL METALLIC TUBING (EMT)

- A EMT shall be 3/4" minimum size.
- B Couplings shall be steel compression type.

2.04 RIGID POLYVINYL-CHLORIDE (PVC) CONDUIT

- A PVC conduit shall be schedule 40, heavy wall type suitable for encasement in concrete and direct burial.
- B Minimum size conduit shall be 3/4" trade size unless noted otherwise on the drawings.
- C Couplings shall be suitable for the conduit installed.
- D PVC conduit shall be joined using PVC solvent cement made specifically for the application.
- E Conduit spacers and standoffs shall be used for each conduit in a ductbank. Provide base or intermediate spacers as required.

PART 3: EXECUTION

3.01 DELIVERY AND STORAGE

Storage and Handling at Job Site. The CONTRACTOR shall store and handle all conduit at the job site, while such materials are awaiting installation, in conformance with the following:

1. Store conduit and accessories in an area protected from weather, moisture or possible damage.
2. Do not store materials directly on the ground.

3.02 GENERAL

- A Conduit bends shall be either standard preformed angles or made using an approved conduit bender.
- B Provide a pulling wire or nylon pullstring in all empty conduits.

3.03 CONDUIT INSTALLATION

- A Conduit ends shall be cut square with a saw and reamed. Threads shall be cut to effect full thread joint engagement. No running threads are permitted.
- B Pull boxes shall be installed in appropriate intervals for long conduit runs.
- C Exposed conduit shall be installed parallel to structural members and surfaces and multiple runs in the same direction shall be parallel with symmetrical bends. Each run or group of runs shall be rigidly supported with galvanized hardware and framing materials including nuts and bolts. No wire ties shall be permitted.
- D Conduits crossing structural expansion joints shall have type OZ or DX bounded watertight expansion and deflection fittings.
- E All conduits shall be clear of structural openings.
- F Every necessary measure shall be taken to prevent the entry of dirt, stones, trash or water in the conduit system.
- G Future or spare conduits shall be capped with threaded cap if exposed, or terminated in equipment or by galvanized couplings plugged flush with the structural surfaces if concealed.
- H Where drawings indicate future equipment, the concealed portions of conduits shall be provided unless shown otherwise on the Drawings.
- I Minimum separation of twelve inches shall be maintained between hot pipeline and electrical conduits.
- J All conduits passing through inside masonry walls or floor slabs except curbed or frame openings, shall be provided with galvanized pipe sleeves, 1 pipe size larger than the conduit trade diameter and cut off flush with the wall or slab. Open space between sleeves and conduits shall be packed and sealed.

- K Structural members and reinforcing steel shall not be cut, burned or damaged in any way. Holes cut through existing floors and walls shall be neatly repaired with zinc-coated pipe rings placed on conduits at entry points.
- L Trapped runs and vertical loops in conduits shall be avoided, but where necessary, shall be drained with proper fittings.
- M Conduit shall not be mounted on ductwork or other mechanical equipment except where necessary to make connections to electrical devices which is part of or mounted on such equipment. Where conduit must be installed on equipment, do not cover access doors, controls, removable panels, etc. or otherwise hinder normal maintenance and repair of the equipment. Where it is necessary to make conduit connections to equipment mounted on vibration mounts, liquid tight flexible conduit shall be used.
- N Underground circuits shall be installed at the minimum cover requirements listed in the NEC unless indicated otherwise on the Contract Drawings. Conduits shall be placed on a minimum 4-inch-deep sand bed and covered with sand a minimum of 4 inches on all sides. Utilize clean backfill, suitably compacted, with the top 4 inches being topsoil. Backfill aggregate shall not measure more than ½ inch in any direction.

3.04 CONDUIT LOCATIONS

- A Rigid Galvanized Steel Conduit (RGSC)
 - 1. RGSC may be used in all locations inside or outside the building except where liquid-tight flexible metal conduit is required, underground or runs in concrete slabs.
 - 2. RGSC shall be used for conduits installed below 10-foot height from the finished floor, all conduits containing wiring rated above 600 volts, conduits subject to mechanical damage, conduits exposed to moisture, all exterior locations subject to weather and all above grade or slab locations unless noted otherwise.
 - 3. **Rigid aluminum conduit with copper free fittings may be used in lieu of rigid steel conduit for all locations where rigid steel conduit is acceptable.**
- B Liquid-Tight Flexible Metal Conduit
 - 1. All motor connections.
 - 2. All equipment connections subject to vibration or movement.
 - 3. Flexible steel conduit, U.L. listed, may be used for connection to interior lighting fixtures.
- C Electrical Metallic Tubing (EMT)

1. EMT shall be installed concealed in building walls or above ceilings.
2. EMT shall not be installed outdoors.

D Polyvinyl-Chloride (PVC) Conduit

1. PVC conduit shall be installed in concrete slabs (size not to exceed 1" trade size unless noted otherwise) and all underground locations.
2. PVC conduit shall not be installed in locations requiring conduits listed in A through C above.

3.05 SUPPORTS AND HANGERS

- A Support and align all raceways, cabinets, boxes, fixtures, etc., in an accepted manner and as specified. Secure all supporting methods by means of toggle bolts in hollow masonry, expansion bolts in solid masonry, concrete pre-set inserts or expansion pre-set inserts or expansion bolts in concrete, machine screws, bolts or welding on metal surfaces and woodscrews on wood construction.
- B Where conduits are hung from horizontal surfaces, bar joists, etc., or where conduits are mounted to vertical surfaces, the conduits shall be supported by hangers or straps at intervals not exceeding 10'-0" and within 3'-0" of any bend, outlet, or junction box.
- C No electrical devices or equipment shall be hung from roof deck.

3.06 CUTTING AND PATCHING

Carefully lay out all work in advance, and where cutting, channeling, chasing, or drilling of the building surfaces is necessary for the proper installation of electrical equipment, carefully perform this work in a manner approved by the ENGINEER. Damaged surfaces shall be repaired at no cost to the OWNER. Concrete shall be cut only with rotary type drilling tools.

END OF SECTION 16111

SECTION 16120
WIRE AND CABLE

PART 1: GENERAL

1.01 SCOPE OF WORK

- A The work performed under this Section consists of providing labor, material, tools, equipment and related items required to furnish, install and place into operation all wire and cable systems.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A Submittals: Section 01300
- B Conduit Systems: Section 16111
- C Grounding: Section 16450
- D Mechanical: Division 15

1.03 REFERENCE STANDARDS

- A UL
- B IPCA
- C NEC

1.04 ACCEPTABLE MANUFACTURERS

- A The Okonite Company
- B Cablec
- C Anixter
- D Houston Wire & Cable
- E Rome Cable
- F Southwire
- G Service Wire Co.
- H Engineer-Approved Equal

1.05 SUBMITTALS

- A The submittal shall comply with the requirements of Section 01300 and Section 16010.
- B The submittal shall include the following:
 - 1. Furnish technical specifications and factory test reports.
 - 2. Insulation type.
 - 3. Temperature rating.
 - 4. Indicate solid or stranded conductors.

PART 2: PRODUCTS

2.01 600 VOLT INSULATION

- A Unless otherwise noted, power and/or control cable shall be single conductor, stranded, soft drawn, annealed copper conductors, with type THW, or THWN or XHHW insulation, with 75°C minimum rating.

2.02 INSTRUMENT CABLE

Wiring for instrument signals shall be #18 AWG, twisted pair with overall shield, stranded copper conductors with PVC insulation and flame-retardant jacket. Belden, Dekeron, Alpha, or approved equal.

PART 3: EXECUTION

3.01 WIRE AND CABLE RATED 600 VOLTS AND BELOW

- A Color coded wire shall be used on 600 volts and below. The following code shall be used:

277/480 Volt, 3-Phase, 4 Wire
Phase A - Brown
Phase B - Yellow
Phase C - Purple
Neutral - Gray

120/208 Volt, 3-Phase, 4 Wire
Phase A - Red
Phase B - Black
Phase C - Blue
Phase D - White

120/240 Volt, Single Phase, 3 Wire
Phase A - Red
Phase B - Black
Neutral - White

Color coding as used by local authority is acceptable.

- B A wire run in conduit solely for grounding shall have an identifying green covering.
- C A green 600-volt conductor used for grounding purposes with single conductor cables of higher voltage requirements will be permitted.
- D Conductor terminations, No. 8 AWG and smaller, shall be made with pressure connected lugs, Buchanan "Termend" or equal. Conductor terminations, larger than No. 8 AWG, shall be made with solderless, compression type copper terminals equivalent to Burndy type YA-L. Compression shall be made with a die set that will make a circumferential crimp. Wire strands shall be thoroughly cleaned and tinned before lug is applied.
- E Bolted connections for electrical conductors, without noncorrosive surfaces, shall be thoroughly cleaned and tinned or covered with a light film of commercial paste to prevent oxidation.
- F Where mechanical assistance is used for pulling conductors, a wire pulling compound having inert qualities that do not harm the wire insulation or covering shall be applied to the conductors before they are pulled into raceways. Interior of all raceways shall be free from grease, filings or foreign matter before conductors are pulled.
- G No wire smaller than No. 12 shall be installed, except as furnished with standard packaged equipment, or specified herein, for low voltage control systems, or fixture wiring.
- H All wiring, except in special cases, shall be run in conduits or raceways. No wire shall be installed until the conduit system is completed and the construction work has progressed beyond the stage where the wire may be damaged.
- I All wires shall be tagged with the OWNER's tagging convention.

END OF SECTION 16120

SECTION 16130
BOXES AND FITTINGS

PART 1: GENERAL

1.01 SCOPE OF WORK

- A The work performed under this Section consists of providing all labor, material, tools, equipment and related items required to furnish and install all junction boxes, pull boxes, outlet boxes and ceiling boxes installed outdoor or indoor.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A Submittals: Section 01300
- B Conduit Systems: Section 16111
- C Grounding: Section 16450

1.03 REFERENCE STANDARDS

- A UL
- B NEC

1.04 ACCEPTABLE MANUFACTURERS

- A Galvanized Boxes and Gutters
 - 1. Circle AW
 - 2. Universal
 - 3. AMF
 - 4. Crouse-Hinds
 - 5. Engineer Approved Equal
- B Cast Iron Boxes and Fittings
 - 1. O-Z/Gedney Company
 - 2. Appleton Electric
 - 3. Crouse-Hinds
 - 4. Engineer Approved Equal
- C Ceiling Boxes and Outlet Boxes

1. Appleton Electric
2. Steel-City
3. Bowers
4. Engineer Approved Equal

1.05 SUBMITTALS

- A All submittals shall comply with the requirements of Section 01300 and Section 16010.
- B The submittal shall include the following:
1. Junction or wall box manufacturer
 2. Type and construction

PART 2: PRODUCT

2.01 GENERAL REQUIREMENTS

- A Unless otherwise specified herein, shown on the drawings or authorized by the OWNER, all outlet boxes and junction boxes located in exterior and industrial areas shall be of the malleable iron type.
- B All outlet boxes, junction and pull boxes located in interior areas shall be galvanized steel, code gauge type.

2.02 PULL AND JUNCTION BOXES

- A Pull and junction boxes located indoors shall be malleable, hot-dipped galvanized inside and outside after fabrication and furnished with a cellular neoprene gasket and stainless steel screws. Size according to the requirements of the National Electrical Code.
- B Boxes located outside shall be NEMA 4x stainless steel.
- C Covers shall be screw-on type with gaskets. Screws shall be stainless steel.

2.03 OUTLET BOXES

- A Outlet boxes for surface mounting shall be zinc-coated cast metal type FS or FD.
- B Device or utility boxes shall be of unit construction of a size required for the number of switches or outlets required. No sectional device boxes will be permitted.

2.04 CONDULETS

- A Conduit outlet bodies may be used in single conduit runs outdoors for pulling wire and branching to multiple devices. No splicing shall be done in condulets.
- B Condulets shall be cast iron alloy with any coatings used in the conduit run. Covers shall likewise be made of the same material and include gasketing and stainless steel screws. Conduit hubs shall have tapered threads.

2.05 WIREWAYS

- A Wireways shall be code gauge formed sheet steel troughs with continuous hinged cover including all necessary fittings. Furnish galvanized indoors and stainless steel outdoors.
- B All wireways shall be furnished without knockouts.
- C Furnish size as required by NEC. Size shown on drawings shall be considered as a minimum.

PART 3: EXECUTION

3.01 DELIVERY AND STORAGE

- A Delivery. Prepare boxes, fittings, and accessories for shipment.
- B Storage and Handling at Job Site. The CONTRACTOR shall store and handle all boxes and fittings at the job site, while such materials are awaiting installation, in conformance with the following:
 - 1. Store boxes, fittings, and accessories in an area protected from weather, moisture or possible damage.
 - 2. Do not store material directly on the ground.

3.02 INSTALLATION

- A All outlet boxes will be mounted with suitable fasteners and they shall contain the proper knockouts. All unused knockouts will remain closed. Outlet or utility boxes concealed in construction shall be firmly secured in place, set true, square and flush with the finished surface for the correct application of cover plates or other devices.
- B Unused screw hole entries shall be closed by means of the appropriate galvanized or brass screwed plugs creating a watertight, dust tight enclosure.

- C All boxes shall be mounted in a readily accessible place and shall be rigidly fixed in position independent of the conduits terminating in them.

END OF SECTION 16130

SECTION 16140
WIRING DEVICES AND PLATES

PART 1: GENERAL

1.01 SCOPE OF WORK

- A This section of the Specifications covers wiring devices, i.e., switches, convenience outlets and special outlets; as well as device plates and special outlet boxes.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A Submittals: Section 01300
- B Boxes and Fittings: Section 16130
- C Grounding: Section 16450

1.03 REFERENCE STANDARDS

- A NEMA
- B UL
- C NEC

1.04 ACCEPTABLE MANUFACTURERS

- A Switches:
 - 1. Pass & Seymour (P&S)
 - 2. Bryant
 - 3. Hubbell
 - 4. General Electric
 - 5. Engineer approved equal
- B Receptacles:
 - 1. Pass & Seymour (P&S)
 - 2. Bryant
 - 3. Hubbell
 - 4. General Electric

5. Engineer-approved equal

1.05 SUBMITTALS

- A The submittal shall comply with the requirements of Section 01300 and Section 16010.
- B The submittal shall include the following:
 - 1. Switch and receptacle manufacturer and catalog number.
 - 2. Switch and receptacle ratings.

PART 2: PRODUCTS

2.01 WALL SWITCHES

- A Wall switches for lighting circuits shall be specification grade AC general use switch with toggle handle, ivory color and rated 20 amperes at 120/277 volts AC. Switches shall be equal to P&S cat. no. 521-I (single pole).

2.02 RECEPTACLES

- A Duplex convenience outlets shall be 3-wire, grounding, 20-amp, 125 volts, specification grade.
- B GFCI receptacles shall be specification grade duplex type with ivory color and rated for 20 amperes, 125 volts AC, NEMA 5-20R configuration with integral ground fault circuit interrupter. Feed through feature shall not be used. Receptacles shall be equal to P&S cat. no. 2091-F.

2.03 DEVICE PLATE AND COVERS

- A Stainless steel plates shall be used on outlet boxes.
- B Plate mounting screws shall be stainless steel.
- C Weatherproof lighting switch covers shall be vertical, hinged cover type with 90° open position and closed position.
- D Weatherproof outlet covers shall be spring door with hasp suitable for pad locking in the closed door position.

PART 3: EXECUTION

3.01 DELIVERY AND STORAGE

- A Delivery. Prepare wiring devices and accessories for shipment in weatherproof and crush resistant packaging.

B Storage and Handling at Job Site. The CONTRACTOR shall store and handle all wiring devices at the job site, while such materials are awaiting installation, in conformity with the following:

1. Store wiring devices and accessories in an area protected from weather, moisture or possible damage.
2. Do not store materials directly on the ground.
3. Handle items to prevent damage to interior or exterior surfaces.

3.02

INSTALLATION

- A Wall switches shall be mounted 4'-0" above finish grade unless noted otherwise.
- B Convenience outlets shall be mounted 18-inches above the finish grade unless noted otherwise.

END OF SECTION 16140

SECTION 16150
COMBINATION STARTERS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The work performed under this Section consists of providing all labor, material, tools, equipment and related items required to furnish install and place into operation all combination starters where installed in separate enclosures or in motor control centers.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 - Shop Drawings
- B. Section 16010 - Electrical General Information
- C. Section 16450 - Grounding

1.03 REFERENCE STANDARDS

- A. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems
- B. ANSI/UL198C - High Intensity Capacity Fuses; Current Limiting Types
- C. ANSI/UL198E - Class R Fuses
- D. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service
- E. FS W-P-115 - Power Distribution Panel
- F. FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses)
- G. FS W-S-865 - Switch, Box (Enclosed), Surface Mounted
- H. NEMA AB 1 - Molded Case Circuit Breakers
- I. NEMA ICS 2 - Industrial Control Devices, Controllers and Assemblies
- J. ANSI/UL 508 - Industrial Control Equipment
- K. National Electrical Code

1.04 ACCEPTABLE MANUFACTURERS

- A. Square D Company
- B. Allen Bradley

- C. General Electric
- D. Cutler Hammer
- E. Engineer Approved Equal

1.05 SUBMITTALS

- A. All submittals shall be made in complete conformance with Section 01300.
- B. The submittal shall include the following:
 - 1. Manufacturer's name and model no.
 - 2. Schematic diagram showing all connections, extra interlock and lock-out relays for the specific combination starter furnished.
 - 3. Enclosure type.
 - 4. Nameplate designations.
 - 5. Combination starter technical data including size and rating.
- C. Furnish all open type combination starter information for starters installed in motor control centers with the motor control center submittal brochure.

PART 2 PRODUCTS

2.01 ENCLOSURES

- A. NEMA Type 4X 316 stainless steel, where installed outdoors, or where subject to weather.
- B. NEMA Type 12 where installed indoors.
- C. Enclosures which are not stainless steel shall be factory prime coated and painted with manufacturer's standard ANSI gray color.

2.02 COMBINATION STARTER

- A. Starters shall be magnetic type full voltage non-reversing (FVNR) or reduced voltage auto transformer (RVAT) type as indicated on the One Line Diagram.
- B. RVAT starters shall be closed transition type with a start coil, a transition coil and a run coil. Each RVAT shall have 50%, 65% and 80% taps and shall be set at 65% unless otherwise noted. The autotransformer shall have a winding temperature switch which shall be connected into the control circuit of the motor starter to stop the motor in the event of overtemperature in the autotransformer winding.

- C. Both FVNR and RVAT starters shall be rated for 480 Volt AC operation and shall be sized as indicated on the One Line Diagram. Where no size is indicated, the size shall be as required for the horsepower rating of the motor.
- D. All starters shall be full Nema size. IEC starters and half-size Nema starters will not be accepted.
- E. All combination starters shall contain the following:
- F. Motor circuit protector type circuit breaker disconnect sized per the NEC for the motor furnished.
- G. External operating handle clearly marked "ON" and "OFF". Lockable in both positions.
- H. "HAND-OFF-AUTOMATIC" (HOA) switch or pushbutton as applicable. Provide only where indicated.
- I. Red, 120 volt, push-to-test transformer type oil-tight pilot light marked "ON". Provide only where indicated.
- J. Green, 120 volt, push-to-test transformer type oil-tight pilot light marked "OFF". Provide only where indicated.
- K. Two (2) extra N.O. and two (2) extra N.C. auxiliary contacts in addition to those required by the schematic diagrams. For future use.
- L. 120 VAC operating coils unless otherwise noted.
- M. Control power transformer with fused primary and secondary. Oversized as necessary for motor space heaters.
- N. Contactor block with three (3) thermal overload units of one-piece construction, interchangeable and resettable. Overload relays shall be capable of being manually and automatically reset and shall be shipped configured for automatic reset. Provide complete with properly sized heater coils.
- O. Nameplate indicating load served and voltage. Comply with Section 16010.
- P. Phase monitor, Motor Saver Model 250, or approved equal. Provide fused protection.
- Q. NEMA type enclosure, size, and rating shall be as shown on the drawings.

2.03 SPARE PARTS

- A. One (1) set of fuses for every fuse type used.
- B. One (1) set of three (3) overload relay heater elements for each starter.
- C. One (1) replacement lamp for each 10 used..
- D. One (1) set of power contacts for each size furnished. Provide start, transition and run contacts for RVAT starters.

- E. One (1) operating coil for each size furnished. Provide start, transition and run coils for RVAT starters.
- F. One (1) control relay for each type used.
- G. One (1) timing relay for each type used.

PART 3 EXECUTION

3.01 DELIVERY AND STORAGE

- A. Delivery. Prepare combination starters and accessories for shipment in crush resistant enclosures.
- B. Storage and Handling at Job Site. The CONTRACTOR shall store and handle all combination starters at the job site, while such materials are awaiting installation, in conformance with the following:
- C. Store combination starters and accessories in an area protected from weather, moisture or possible damage.
- D. Do not store materials directly on the ground.
- E. Handle items to prevent damage to interior or exterior surfaces.
- F. If items are stored inside the proposed building, consideration shall be given to weight of the items and the effect of concentrated loads on the building slabs, foundation, and other structural members. CONTRACTOR shall contact ENGINEER or OWNER for permission to store materials with a load exceeding 200 pounds per square foot.

3.02 INSTALLATION

- A. Install overload heaters correlated with the actual nameplate full-load current of motors installed. Select heaters which also provide protection at locked rotor conditions.
- B. Adjust magnetic trip setting of circuit breaker in accordance with the NEC and exact motor furnished.
- C. Mount all starters with fasteners specifically approved for the surface.
- D. All starters shall have adequate operating space in front as dictated by the NEC.

END OF SECTION 16150

SECTION 16160
PANELBOARDS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The work performed under this Section consists of providing all labor, material, tools, equipment and related items required to furnish, install, and place into operation all lighting and power distribution panelboards either in their own enclosures or installed in other equipment such as motor control centers.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Submittals: Section 16010.
- B. Electrical General Information: 16010.
- C. Grounding: 16450.
- D. Low Voltage Motor Control Center: 16921.

1.03 REFERENCE STANDARDS

- A. NEMA PB-1
- B. ANSI
- C. NEC
- D. OSHA
- E. Federal Spec W-P-115A, Type 1, Class 1
- F. Federal Spec W-C-375A, WS 865 (Breakers & Switches)
- G. Underwriters UL67, UL50

1.04 ACCEPTABLE MANUFACTURERS

- A. Cutler Hammer Corporation.
- B. General Electric Company
- C. Square D Company
- D. Engineer Approved Equal

1.05 SUBMITTALS

- A. Make submittals in accordance with Section 16010.
- B. Include the following:
 - 1. Manufacturers' catalog number.
 - 2. Size of main lugs, main circuit breaker and main bus.
 - 3. Size, type and quantity of circuit breakers. Include panel schedule for each panel.
 - 4. Type of bus material.
 - 5. Voltage rating, e.g. 120/208 VAC, 3 phase, 4 wire.
 - 6. Characteristic trip curve of largest circuit breaker plotted on 5 cycle log-log paper.
 - 7. Other data sufficient to substantiate that the materials conform to the requirements of this section.
- C. Submit O&M Manuals in accordance with Section 16010.

PART 2 PRODUCTS

2.01 GENERAL

- A. The equipment included in this Section consists of several panel types designated as lighting and power panelboards for use in applications up to 600 volts with interrupting ratings of 10,000 through 100,000 amps. Cabinets are galvanized code gauge steel and trims shall be door-in-door with one door over the interior and an additional door over the wiring gutters. Fast mounting type with release mechanisms mounted behind locked door which are keyed alike. The finished product shall bear an Underwriters Laboratory label and any panel, whether service entrance or not, shall bear a "Suitable for Service Entrance" label if it has the minimum number of disconnects to so classify it.

2.02 BREAKERS

- A. Ratings shall be as shown on the drawings. Interrupting rating shall be as indicated on the drawings or as required to withstand the available fault current, whichever is greater.
- B. Unless otherwise noted on the drawings, all breakers shall have the following minimum ratings according to Federal Spec WP375A or better:

Breaker Type	WP 375	Trip Range	Poles	Interrupting Capacity
Bolted	2a	0-100	1	10,000 @ 277V
Bolted	2d	0-100	2&3	14,000 @ 480V
Bolted	3B	101-225	2&3	STD
Bolted	4B	226-400	2&3	STD
Bolted	5A	401-800	2&3	STD

- C. Breakers shall be bolt-on quick-make, quick-break type having thermal and magnetic elements. Two and three pole circuit breakers shall be common-trip type with one handle. Handle ties are not acceptable.

- D. Breakers shall be fully rated for operation at 40 C with no derating necessary.
- E. Lugs: Approved for 75° C copper rated conductors.
- F. Provide any test kits necessary to calibrate and test the circuit breakers.

2.03 PANELBOARDS

- A. 120/240 V panelboard shall be Square D Type NQOD, or approved equal.
- B. 277/480 V panelboard shall be Square D Type NF, or approved equal.

2.04 GROUND BUSSES

- A. Each panel shall have a separate copper ground bus.

2.05 MAIN BUSSES AND NEUTRAL

- A. All busses shall be tin plated copper with full capacity neutral where required of a type and size as shown on the drawings. Minimum bus ampacity shall be 100 Amps unless otherwise noted.
- B. Bussing shall be full size distributed phase sequence type extending the full length of the panel.

2.06 SEQUENCING

- A. All breakers shall be installed in panels in the same sequences shown in the schedules.

2.07 BOX SIZE

- A. Minimum box width is 20-inches.
- B. Box length shall be sufficient for 42 circuits unless otherwise noted on the Plans.

2.08 CABINET

- A. Code gauge steel per NEMA PB1-1977 and UL 67.
- B. Nema 12 enclosure for indoor locations.
- C. NEMA 3R for outdoor locations.

2.09 IDENTIFICATION

- A. Identify all circuit breakers with a circuit number corresponding to those shown on the panel schedules.
- B. Provide a typewritten directory. Pencil in spares. Install directory in a permanent clear plastic holder securely attached to the panel door.
- C. Provide a nameplate per 16010.

PART 3 EXECUTION

3.01 DELIVERY AND STORAGE

- A. Delivery. Prepare panelboards, circuit breakers and accessories for shipment to job site.
- B. Storage and Handling at Job Site. The CONTRACTOR shall store and handle all panelboards at the job site, while such materials are awaiting installation, in conformance with the following:
 - 1. Store panelboards, circuit breakers and accessories in an area protected from weather, moisture or possible damage.
 - 2. Do not store materials directly on the ground.
 - 3. Handle items to prevent damage to interior or exterior surfaces.
 - 4. If items are stored inside the proposed building, consideration shall be given to weight of the items and the effect of concentrated loads on the building slabs, foundation, and other structural members. CONTRACTOR shall contact ENGINEER or OWNER for permission to store materials with a load exceeding 200 pounds per square foot.

3.02 INSTALLATION

- A. The CONTRACTOR shall receive, set in place, wire and provide all labor incident to demonstration that the panels form an integral system prior to final acceptance.
- B. Mount panel so that bottom is 3'- 0" from floor level. Mount lower only where necessary to have top breaker no more than 6'- 6" above floor level.
- C. Provide wire tags on each wire as it leaves the panel and again at each termination.
- D. Provide a neatly type written directory identifying each circuit as to the load it serves. Label spares in pencil. Indicate panelboard source of power.
- E. Take and record load on each lighting circuit; identify the number of convenience outlets on each circuit and record the same. Identify the loads on all other circuits and record the VA of each.

END OF SECTION 16160

**SECTION 16165
CABINETS AND ENCLOSURES**

PART 1 GENERAL

1.01 WORK INCLUDED

The work under this Section consists of furnishing and installing all cabinets and enclosures required.

1.02 REFERENCES

- A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. ANSI/NEMA ICS 1 - Industrial Control Systems.
- C. ANSI/NEMA ICS 4 - Terminal Blocks for Industrial Control Equipment and Systems.
- D. ANSI/NEMA ICS 6 - Enclosures for Industrial Control Equipment and Systems.

1.03 SUBMITTALS

- A. Submit shop drawings in accordance with Section 16010.
- B. Include wiring schematic diagram, wiring diagram, outline drawing and construction diagram as described in ANSI/NEMA ICS 1.

PART 2 PRODUCTS

2.01 HINGED COVER ENCLOSURES

- A. Type 12: For indoor use. Hoffman Concept Series, or approved equal.
- B. Type 4X Stainless Steel: Indoor or outdoor use subject to extreme conditions such as splashing water, hose-directed water or wind blown rain. Hoffman Bulletin A-4, 316 SS, or approved equal.
- C. Finish: Manufacturer's standard finish.
- D. Covers: Except where otherwise called for continuous hinge, held closed by quarter turn latch and staple for padlock.
- E. Back Panel for Mounting Terminal Blocks or Electrical Components: 14 gauge steel, white enamel finish.

2.02 CABINETS

- A. Cabinet Boxes: Galvanized steel with removable endwalls.
- B. Cabinet Fronts: Steel, finish in gray baked enamel, unless otherwise called for.

2.03 TERMINAL BLOCKS AND ACCESSORIES

- A. Terminal Blocks: ANSI/NEMA ICS 4; UL listed.
- B. Power Terminals: Unit construction type, closed-back type, with tubular pressure screw connectors, rated 600 volts.
- C. Signal and Control Terminals: Modular construction type, channel mounted; tubular pressure screw connectors, rated 300 volts.
- D. Interior Wireway and Moulding: Panduit wireway size as read; conductor tie-wrapped (keep tie-wrap to a minimum); sufficient slack wiring and bound together for wiring to devices on movable panels and doors.

2.04 FABRICATION

- A. Shop assemble enclosures and cabinets housing terminal blocks or electrical components in accordance with ANSI/NEMA ICS 6.
- B. Provide conduit hubs on enclosures.
- C. Provide protective pocket inside front cover with schematic diagram, connection diagram, and layout drawing of control wiring and components within enclosure.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install cabinets and enclosures plumb; anchor securely to wall and structural supports at each corner, minimum.
- B. Provide accessory feet for free-standing equipment enclosures.
- C. Install a trim plumb.
- D. Furnish a nameplate for each cabinet and enclosure per Section 16010.

END OF SECTION

SECTION 16180
SAFETY SWITCHES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The work performed under this Section consists of providing all labor, material, tools, equipment and related items required to furnish and install safety switches.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Submittals: Section 16010.
- B. Electrical General Information: Section 16010

1.03 REFERENCE STANDARDS

- A. NEMA KSI-1991
- B. ANSI
- C. NEC
- D. OSHA
- E. UL
- F. FED. SPEC. WS-865c

1.04 ACCEPTABLE MANUFACTURERS

- A. Square D Company
- B. General Electric Company
- C. Cutler Hammer Corporation
- D. Engineer Approved Equal

1.05 SUBMITTALS

- A. Make submittals in conformance Section 16010.
- B. Include the following:
 - 1. Manufacturer's catalog number.
 - 2. Voltage and current rating.

3. Enclosure type.
4. Nameplate designation.
5. Technical data including fuse curve plotted on 5 cycle log-log paper.
6. Additional data as necessary to substantiate that the materials conform to the requirements of this section.

PART 2 PRODUCTS

2.01 STANDARD DISCONNECT SWITCH

- A. Type: Heavy duty Type HD fused or non-fused as shown on the Plans. U.L. labeled.
- B. Construction: Quick-make, quick-break operating handles with provisions for padlocking in the "off" position. Handle interlocked with door to prevent unauthorized opening with the switch in the "on" position. Provide with equipment ground lug.
- C. Enclosure: NEMA 12 indoors. NEMA 4X SS surface mounted outdoors.
- D. Ratings: Horsepower rated for 250 volts A.C. or 600 volts A.C. as required for their service.
- E. Fuses: Dual element type sized per N.E.C. Bussman, Chase Shawmut, or equal.

2.02 MANUAL TRANSFER SWITCH

- A. Type: Double pole, double throw. With solid neutral assembly. Load make and load break. U.L. Listed.
- B. Construction: Quick-make, quick-break operating handles with provisions for padlocking in the "off" position and in the "on" positions. Handle interlocked with door to prevent unauthorized opening with the switch in the "on" position. Provide with equipment ground lug.
- C. Enclosure: NEMA 12 indoor. NEMA 4X SS surface mounted outdoors.
- D. Ratings: Horsepower rated for 250 volts A.C. or 600 volts A.C. as required for their service.
- E. Lugs: Fully rated for continuous operation at 75 deg. C.
- F. Fuses: Non-fused.

2.03 NAMEPLATES

- A. Install a nameplate on the switch identifying the Normal and Emergency as well as the Off positions. Comply with Section 16010.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install at locations shown on the Plans.
- B. Mounting height to be 4'- 0" above finished floor to bottom of switch unless otherwise noted. Maximum height of operating handle shall not exceed 5'-6".
- C. Provide channel iron or Unistrut supports for mounting. Per Section 16010.

END OF SECTION 16180

SECTION 16450
GROUNDING

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. The work performed under this Section consists of providing all labor, material, tools, equipment and related items required to furnish and install a radial electrical grounding system.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Submittals: Section 01300

1.03 REFERENCE STANDARDS

- A. NEC
- B. IEEE Standard 142-1972 (Recommended Grounding)
- C. UL

1.04 SUBMITTALS

- A. All submittals shall be made in complete conformance with Section 01300.

PART 2: PRODUCTS

2.01 MATERIAL

All wire and fittings shall be 98 percent conductivity copper.

PART 3: EXECUTION

3.01 SAFETY GROUNDING OF EQUIPMENT

- A. Safety grounding of equipment will be generally accomplished by providing a 4th equipment wire, as shown on the drawings which will be no less than the size recommended in Article 250 of the National Electric Code. This ground will extend throughout the system by means of insulated green ground wires connected to ground buses in each motor control center, panelboard and terminate on each outlet box, or grounding terminal of the motor.

END OF SECTION 16450

SECTION 16950
CALIBRATION AND TESTING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Provide all equipment and labor required for calibration, setting and testing as described herein or otherwise required. All tests are to be witnessed by the Owner and Engineer. Give written notification of the tests at least seven days prior. Repair or replace all defective material, equipment or workmanship disclosed as a result of these tests at no additional cost to the Owner.

1.02 RECORDS

- A. Provide the Owner six (6) copies of reports of all of the following tests including the piece of equipment or wiring tested, the date tested, weather conditions, and test value results. Include test reports in Operations and Maintenance Manuals where applicable. Report forms shall be the same or similar to those attached to this specification.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Use meters, meggers and other test devices specifically approved for the test.
- B. Test devices to be provided with calibration certificate.

PART 3 EXECUTION

3.01 MEGGER TESTS

- A. Use a minimum 500 volt megohmmeter.
- B. Take each reading for at least one minute.
- C. Include the following tests:
 - 1. 115 and 230 volt motors..... 5.0 Megohms
 - 2. 460 volt motors..... 7.0 "
 - 3. 600 volt wiring up to 1000 ft..... 25.0 "
- D. Test all wiring including main service feeders, motor feeders and branch circuit wiring.

3.02 GROUND TESTING

- A. Take ground resistance measurements in normally dry weather, not less than 48 hours after rainfall, with the ground under test isolated from other grounds.

- B. Measure the resistance of each ground rod. Submit in writing to the Owner a record indicating the rod location, the resistance measured and the soil condition at the time.
- C. Take ground resistance measurements on the building water service where it is used as a ground also.
- D. Install additional grounding if the resistance to ground measures more than 25 OHM's at any location.

3.03 MOTOR TESTING

- A. Megger test motors for insulation and stator winding resistance.
- B. Dry out any wet insulation by use of space heaters or other approved methods.
- C. Check coupling alignment, shaft end play, lubrication and other mechanical checks as required. Follow manufacturer's instructions.
- D. Check for proper rotation.
- E. Combined or coupled motor and pump vibration testing under actual pumping conditions. At both full and reduced speeds.

3.04 RECEPTACLES

- A. Test all receptacles for proper connections and grounding. Use an approved plug in tester.

3.05 CONTROL CIRCUITS

- A. Check all circuits for continuity, proper connection and proper operations.
- B. Set all time delay relays and timers for the desired operation. Record the settings, indicating the relay or timer, its location and the setting used. Verify all settings with a stopwatch.

3.06 LIGHTING

- A. Turn on all lights after lamping them with new lamps.
- B. Turn on all lights at each panelboard with lights on and submit typewritten results to the Owner. Results to include panelboard number and location, branch circuit number and load served, and amperage reading.
- C. Allow outdoor lights to remain on for 72 hours to check ballasts as well as lamps. Replace any defective material.

3.07.1 MOTOR STARTERS

- A. Set all motor circuit protectors, all feeder circuit breakers and all overload relays.
- B. Record the following information and submit the same to the Engineer for checking:

1. Starter number..
 2. Load served and location.
 3. Full load amps.
 4. Locked rotor amps.
 5. Overload heater unit used.
 6. Overload relay setting used.
 7. MCP setting used.
- C. Take and record amperage readings on all feeders and motors to ensure proper phase balance.

3.08 CONTROLS AND INSTRUMENTATION

- A. Test controls and instrumentation for continuity and proper operation.
- B. Calibrate, set and test instruments in accordance with the Instrument Supplier's published recommendations.
- C. Provide written records of all tests. Include certifications and settings for all instruments.

END OF SECTION 16950