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TECHNICAL SPECIFICATIONS FOR INTERIM MEASURE PHASE II UPGRADES RECOVERY
WELL ADDITION TO EXISTING TREATMENT FACILITY SITE 11 OLD CAMDEN COUNTY
LANDFILL NSB KINGS BAY GA
11/6/1996
ABB ENVIRONMENTAL SERVICES, INC

TECHNICAL SPECIFICATIONS

**INTERIM MEASURE PHASE II UPGRADES
RECOVERY WELL ADDITION TO EXISTING
TREATMENT FACILITY
SITE 11 - OLD CAMDEN COUNTY LANDFILL
NAVAL SUBMARINE BASE
KINGS BAY, GEORGIA**

6 NOVEMBER 1996

**ABB ENVIRONMENTAL SERVICES, INC.
1400 CENTERPOINT BOULEVARD, SUITE 158
KNOXVILLE, TENNESSEE 37932**

**IM PHASE II UPGRADES RECOVERY WELL ADDITION
TO EXISTING TREATMENT FACILITY**

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Designer certifies new work associated with the addition of a new recovery well, associated conveyance, and connection to the existing treatment system. Original work related to the existing system is reflected in Technical Specification dated August 5, 1994.

R. J. G. B.
11/6/96

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DIVISION 1
GENERAL REQUIREMENTS

SECTION 01010

SUMMARY OF WORK

PART 1 - GENERAL

1.01 BACKGROUND

Results of previous site investigation activities at the Old Camden County Landfill, Site 11, at Naval Submarine Base (NSB), Kings Bay indicate that volatile organic compounds (VOC) are present within the surficial aquifer. The extent of VOC contamination within the groundwater extends off of NSB property into an adjacent subdivision. Due to the nature of the VOC contamination and its presence in the surficial aquifer beneath a residential community, an Interim Measure (IM) was necessary. The upgrades to the existing IM are necessary to improve its effectiveness in removing and containing contaminated groundwater. Air monitoring conducted during previous work at the site has not indicated the need for respiratory protection. Results of soil vapor sampling do not suggest that VOCs will be present in the soil to be disturbed during the work associated with this scope. No conditions that are eminently threatening to human health are expected. Therefore, Level D personal protective equipment (PPE) will be required for all associated construction activities. Unanticipated site conditions discovered during routine health and safety monitoring may require an upgrade to higher levels of protection. Subcontractor will also be required to conform to OSHA 29 CFR 1910.120.

1.02 PRELIMINARY ACTIVITIES

Preliminary activities to be conducted prior to the field work include arranging for acquisition of necessary permits and obtaining base security; conducting a reconnaissance of the site to determine logistics and meet with ABB Environmental Services (ABB-ES), here and after referred to as the Contractor, and Base personnel to make access and security arrangements. A preconstruction meeting with the General Subcontractor will be conducted on the mobilization date. The Subcontractor will provide methods of conducting work such as trenching, laying pipe, and pipe testing. The Subcontractor will also provide a schedule of events. Subcontractor personnel involved in this project will also be required to attend a health and safety meeting presented by ABB-ES personnel, and be briefed on planned activities related to site preparation and the IM Conveyance and Treatment installation.

1.03 SUMMARY OF WORK

Work to be completed includes installation of piping and all associated valves, pumps, and appurtenances; construction of a recovery well vault; excavation and backfilling for the installation of all electrical and groundwater water conveyance lines; and demolition of one recovery well vault and backfill of vault location.

END OF SECTION

SECTION 01025

MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. Summary of Work: Section 01010

1.02 SCOPE OF PAYMENT

- A. Payments to the Subcontractor will be made in accordance with the provisions of the Contract Conditions.
- B. The Subcontractor shall accept the lump sum total of the purchase order as full payment to furnish all materials, labor, tools, equipment, and incidentals necessary to complete work; for performing all work contemplated and embraced by the Contract; for all loss or damage, through negligence of the Subcontractor, arising from the nature of the work, or from the action of the elements, or from any unforeseen difficulties which may be encountered during the execution of the work and until its final acceptance by the Resident Engineer; and for all expenses incurred in consequence of the suspension of the work except as specified in the Contract Conditions.
- C. No extra payment will be made to the Subcontractor for any expense or delays caused by inadequate work, lack of progress, defective workmanship, or rescheduling of work by other subcontractors, or equipment and material suppliers.

1.03 INCIDENTAL WORK

- A. Incidental work items included in the lump sum price include, but are not limited to, the following items:
 - 1. Office and material storage facilities.
 - 2. Sanitary facilities and trash removal.
 - 3. Signs, barricades, and warning lights.
 - 4. Restoration of disrupted areas not designated on the Drawings.
 - 5. Cooperation with other Subcontractors and others.
 - 6. Mobilization and demobilization of equipment.

1.04 DESCRIPTION OF PAY ITEMS

- A. The following pay items describe the measurement of and payment for the work to be done under the respective items listed in the Bid.
- B. The lump sum price stated in the Bid shall constitute full compensation, as herein specified, for all items of the completed work.
- C. For work not covered in the original scope of work, a change order may be issued utilizing unit prices or a lump sum price; the method of change order is to be determined by the Resident Engineer.

1.05 PAY ITEMS

Item No. 1 - Site Work

- A. Method of Measurement:
 - 1. Lump sum for purchased items, including labor.
- B. Lump Sum Payment: Payment shall be made at the contract lump sum price which shall be full compensation for all labor, equipment, materials, and tools required for completing installation of the conveyance lines and proper connections and completion of all work shown in specification and drawings.

1.06 BID SUBMITTALS

- A. Bid submittals shall encompass all necessary labor, equipment, materials, and general conditions necessary for the performance of the work identified in the Specifications and Drawings.

END OF SECTION

SECTION 01041

PROJECT COORDINATION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Subcontractor to coordinate all work under this Contract, with the ABB-ES Resident Engineer.
- B. Make arrangements for temporary storage of materials and supplies and for the timely delivery to the job site.
- C. Maintain up to date progress records and record drawings.
- D. Maintain the project site in a neat condition.
- E. Coordinate the work of subcontractors, equipment, and material suppliers.
- F. Project work must not interfere with the Naval Submarine Base activities.
- G. Prior to commencing work on site, coordinate with the Resident Engineer and the Kings Bay Naval Subbase for access routes and procedures to be followed.
- H. Facilitate the Subcontractor's right-of-access to all locations through the Project Client and the NSB Command.
- I. Designate parking, equipment storage, and equipment decontamination areas.

END OF SECTION

SECTION 01091

REFERENCE CODES AND STANDARDS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Comply with local, state, and national codes applicable to the proposed construction including but not limited to the following.
1. OSHA - National Occupational Safety and Health Act.
 2. BOCA - Building Officials and Code Administrators - "Basic Building Code."
 3. Associated General Contractors of America - "Manual of Accident Prevention in Construction."
 4. U.S. Army Corp of Engineers Safety and Health Requirements Manual, EM385-1-1.
 5. National Electrical Code.
 6. National Fire Protection Association.
- B. Applicable standards, tests and recommended methods from trade, industry and professional organizations specified in technical specifications of this Contract determine quality and methods of design, fabrication and testing.

1.02 EDITION DATES

- A. Edition dates of standards and codes specified in this Contract shall be that which are current as of the Bid date or date of Contractor-Subcontractor Agreement when there are no bids.

END OF SECTION

SECTION 01125

SPECIAL PROJECT PROCEDURES

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. Site Maintenance: Section 01710.
- B. Project Record Documents: Section 01721.

1.02 SUBCONTRACTOR'S CERTIFICATION

- A. Certify in writing that all employees working pursuant to this contract are properly trained for this type of work.
- B. This certification shall state that:
 - 1. All employees are current in their training for that level required by their job function and responsibility, as required by 29 CFR part 1910.
 - 2. The individual who signs the certification of training on behalf of the Subcontractor has the Subcontractor's authority to certify that this training information is accurate and complete.
 - 3. The Subcontractor agrees to abide by all applicable federal, state, and local laws and regulations.

1.03 SUBCONTRACTOR'S RESPONSIBILITIES

- A. Subcontractor shall provide all necessary personnel, equipment, and materials to perform the work. The following are also required:
 - 1. Subcontractor shall provide all medical monitoring, training, certification, and health and safety equipment for Subcontractor personnel as required in the Contractor Health and Safety Plan (HASP) and the NIOSH/OSHA/USCG/EPA Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities. It is understood that the Subcontractor shall perform all on-site services at a level of safety that is equivalent at or exceeds the level of safety established in the Contractor HASP. The Contractor HASP will be available for review at the site prior to construction activities.
 - 2. Subcontractor shall be subject to security clearance procedures set forth in section 1.06 of this specification.

3. Subcontractor personnel shall attend an initial health and safety briefing and obtain necessary Naval Submarine Base security badges on the first day of work. It is anticipated that the IM recovery well addition activities will take approximately 1 week to complete.
 4. Anticipated start date for mobilization is 3 December 1996.
 5. Provide a daily authorized site representative responsible for all Subcontractor work. The representative will meet at least daily with the Resident Engineer.
- B. The methods, procedures and techniques to be used by the Subcontractor are the responsibility of the Subcontractor, and shall be designated to meet the intent of the technical specifications herein.

1.04 CONTRACTOR'S RESPONSIBILITIES

Contractor, or on-site engineer (resident engineer), will provide the following services:

- A. Coordinate all work to be completed by Subcontractor.
- B. Observe the Subcontractor's activities as required.
- C. Consider written requests on the part of the Subcontractor to charge standby time for delays resulting from actions of Contractor or the NSB Kings Bay Command. Contractor will determine the merits of such requests and, when warranted, approve standby time in writing.

1.05 HEALTH AND SAFETY REQUIREMENTS

- A. In performance of the work, Subcontractor shall, as a minimum, satisfy all federal, state and local statutes, regulations and ordinances regarding health and safety, including, but not limited to, OSHA 29 CFR 1910.120 Hazardous Waste Operations and Emergency Response, Final Rule, U.S. Department of Labor, Occupational Safety and Health Administration, March 1990. These included: a requirement that all on-site personnel receive a minimum of 24 hours of formal hazardous waste safety training. Subcontractor must submit a certification to Contractor stating that each of its employees working on-site is in a Medical Monitoring program and has completed the appropriate training and field experience in compliance with regulations before the field work begins. Subcontractor shall also comply with the Health and Safety Plan developed by Contractor for the site.
- B. Subcontractor shall be and remain solely responsible and liable for compliance by its employees, agents and subcontractors with the Health and Safety Plan and procedures for the site, and shall hold Contractor harmless from all claims,

damages, suits, losses, and expenses including suits by its employees in any way arising from non-compliance with the Health and Safety Plan.

- C. The minimum requirements for a Health and Safety Plan (HASP) during the previous programs has been developed by Contractor based on the information currently available to it and will be supplied to Subcontractor before field activities begin. Based on what Contractor currently knows about the potential for chemical exposure to personnel at the site, it is expected that the work in this program will require Level D protection.
- D. U.S. Army Corp of Engineers Safety and Health Requirements Manual, EM385-1-1.

1.06 SECURITY REQUIREMENTS FOR SUBCONTRACTOR PERSONNEL

In addition to any other requirements set forth in this Subcontract or required by the installation, Subcontractor shall be responsible for providing the following information to Contractor so that arrangements may be made to facilitate access to the installation:

- A. The full name of any Subcontractor personnel who will require access to the facility
- B. Date of birth
- C. Places of birth
- D. Social security numbers
- E. Citizenship

Additionally, please be advised that vehicle registrations and proof of insurance must be provided by Subcontractor for any vehicles owned or operated by Subcontractor which will require access to the installation.

1.07 REFERENCES

- A. Occupational Safety and Health Administration (OSHA) Standards. Title 29, Code of Federal Regulations, Part 1910 and 1926 (29 CFR 1910 and 1926).
- B. United States Environmental Protection Agency, "Standard Operating Safety Guides," November, 1984. Corps of Engineer Safety Manual.
- C. The most stringent requirement among these references shall apply.

END OF SECTION

SECTION 01151

TEMPORARY FACILITIES

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. Special Project Procedures: Section 01125
- B. Site Maintenance: Section 01710

1.02 DESCRIPTION

A. Work Included:

1. Provide such temporary facilities as the work may warrant.
2. Facilities include, but are not limited to:
 - a. Subcontractor's office and storage facilities.
 - b. Sanitary facilities conforming to local codes and OSHA requirements.
 - c. Trash containers.
 - d. Personal safety equipment.
 - e. Signs, barricades, and warning lights.
3. Upon completion of the work, completely remove all Subcontractor installed temporary facilities at the site. Repair all damage caused by the installation.

1.03 SANITARY FACILITIES

A. Sanitary Conveniences:

1. Provide chemical type toilets and maintain in sufficient numbers, for the use of all persons employed on the job, and properly screen from public observation, at suitable locations, in accordance with State and Local ordinances.

- a. Empty periodically as required and disposed of in a timely manner satisfactory to the Resident Engineer.
- b. When no longer required, remove from the site and dispose of the contents in a manner satisfactory to the Resident Engineer.

END OF SECTION

SECTION 01600

MATERIAL CONTROL

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This Section covers acceptance and storage of materials and equipment to be installed in this Project.
- B. Package, ship, receive, inspect, handle, and store materials and equipment in a manner that will protect such items from damage or deterioration.

1.02 ACCEPTANCE AT SITE

- A. General:
 - 1. Examine all materials and equipment upon arrival.
 - 2. Damaged or nonconforming items shall be removed immediately to a separate storage area for expeditious removal from the site.

1.03 STORAGE AND PROTECTION

- A. General:
 - 1. Provide open and closed storage areas for equipment and materials for protection from vandalism and weather damage.
 - 2. Store materials and equipment in accordance with these specifications and any manufacturer's instructions for additional storing precautions that may be applicable to specific materials and equipment.
 - 3. Store materials and equipment on blocking or pallets a sufficient distance above the ground or floor to protect from mud, standing or flowing water or similar hazards. Use waterproof covers on storage outdoors.
 - 4. Provide indoor storage or heated indoor storage for material and equipment that normally require such protection.

END OF SECTION

SECTION 01710

SITE MAINTENANCE

PART 1 - GENERAL

1.01 RELATED REQUIREMENTS SPECIFIED ELSEWHERE:

- A. Summary of Work: Section 01010.

1.02 DESCRIPTION

- A. Maintain premises free from accumulations of waste, debris, and rubbish, caused by operations.
- B. At completion of work, remove waste materials, rubbish, tools, equipment, machinery, and surplus materials, and clean all sight-exposed surfaces.
- C. At completion of work, remove Subcontractor equipment and materials from the site.

1.03 SAFETY REQUIREMENTS

- A. Standards: Maintain project in accordance with following safety and insurance standards:
 - 1. Manual of Accident Prevention in Construction - AGC.
 - 2. U.S. Army Corp of Engineers Safety and Health Requirements Manual, EM385-1-1.
- B. Hazards Control:
 - 1. Prevent accumulation of wastes which create hazardous conditions.
 - 2. Provide adequate ventilation during use of volatile or noxious substances.
- C. Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.
 - 1. Do not burn rubbish and waste materials on Naval Subbase property. Non-hazardous materials will be disposed in an approved off-base landfill.
 - 2. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.

3. Do not dispose of wastes into streams or waterways.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Use only cleaning materials recommended by manufacturer of surface to be cleaned.
- B. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 - EXECUTION

3.01 DURING CONSTRUCTION

- A. Execute cleaning to ensure that the site is maintained free from accumulations of waste materials and rubbish.
- B. At reasonable intervals during progress of work, clean site, and dispose of waste materials, debris, and rubbish. Resident Engineer may require additional cleaning if in his/her opinion it is needed.
- C. Provide on-site containers for collection of waste materials, debris, and rubbish.
- D. Remove waste materials, debris and rubbish from site and legally dispose of at a permitted public or private disposal facility off Base property.
- E. Handle materials in a controlled manner with as few handlings as possible; do not drop or throw materials from heights.

3.02 FINAL CLEANING

- A. In preparation for substantial completion, conduct final inspection of site.
- B. Maintain cleaning until project is substantially complete.
- C. Resident Engineer will make final determination of site cleanliness and Subcontractor will continue to clean site to satisfaction of Resident Engineer.

END OF SECTION

SECTION 01721

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Keep accurate record documents for all additions, substitution of material, variations in work, and any other revisions to the Contract Documents.

1.02 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintain at job site, one copy of:
 - 1. Contract Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders.
 - 5. Other Modifications to Contract.
 - 6. Health and Safety Plan.
 - 7. Subcontractor's Certifications.
 - 8. Progress payment quantity field notes and records.
 - 9. Subcontractor's daily reports, including:
 - a. Records of all site work.
 - b. Inspection records.

1.03 SUBMITTALS

- A. At completion of construction, the Subcontractor shall deliver a copy of all documents pertaining to construction activities to the Resident Engineer.
- B. Accompany submittal with transmittal letter containing:
 - 1. Date.
 - 2. Project title and number.
 - 3. Subcontractor's name and address.
 - 4. Certification that each document as submitted is complete and accurate.
 - 5. Signature of Subcontractor, or Subcontractor's authorized representative.
- C. Documents must be submitted to the Resident Engineer at project completion as a condition of final payment.

1.04 RECORDING

- A. Clearly label each document "PROJECT RECORD."
- B. Keep record documents current.
- C. Contract Drawings: Legibly mark to record actual construction as applicable:
 - 1. Location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure.
 - 2. Field changes of dimension and detail.
 - 3. Changes made by Change Order or Field Order.
 - 4. Details not on original Contract Drawings.
- D. Specifications and Addenda shall be legibly marked up to record changes made by change or field orders, or other matters not originally specified.

END OF SECTION

DIVISION 2

SITE WORK

SECTION 02016

EXISTING UTILITIES AND UNDERGROUND STRUCTURES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Contractor will receive approval (permit) from the Naval Subbase Code N522 prior to excavation anywhere, especially in areas where it is reasonable to expect the presence of existing utilities, whether shown on the Drawings or not.
- B. Subcontractor shall be responsible for locating and protecting all utilities within and adjacent to the work area.
- C. Subcontractor shall be responsible for any and all damage to any existing utilities, caused by his efforts.
- D. Contact the Resident Engineer as soon as any damage is uncovered.
- E. The Resident Engineer shall make the determination as to who makes the necessary repairs.
- F. In areas where existing underground structures are shown or suspected, carefully uncover such structures to such extent as to enable the Resident Engineer to determine what adjustments if any need to be made to accommodate the presence or removal of such structures.
- G. Subcontractor shall make all efforts necessary to immediately repair any and all damage caused by his/her efforts prior to continuing regular contract work.

END OF SECTION

SECTION 02221

EXCAVATION, TRENCHING, BACKFILL AND COMPACTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. Special Project Procedures: Section 01125
- B. Existing Utilities and Underground Structures: Section 02016

1.02 DESCRIPTION OF WORK

- A. Work Included:
 - 1. Earthwork/trenching for Conveyance System.
 - 2. Backfilling of excavations.
 - 3. The compaction of all backfill and subgrade materials.
 - 4. Disposal of material not suitable for backfill.

1.03 JOB CONDITIONS

- A. Existing Utilities:
 - 1. Locate underground utilities in the areas of work.
 - 2. If utilities are to remain in place, provide adequate means of protection during earthwork operations.
 - 3. If uncharted or incorrectly charted piping or other utilities are encountered during excavation, consult the Resident Engineer immediately for directions as to procedure.
 - 4. Cooperate with the Naval Subbase in keeping respective services and facilities in operation.
 - 5. Repair damaged utilities to satisfaction of the Resident Engineer.
 - 6. Do not interrupt existing utilities serving facilities occupied and used by the Naval Subbase.

B. Protection of Persons and Property:

1. Protect the public, structures, utilities, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.
2. Caution tape will be provided by the Subcontractor and will be placed around excavated areas at all times.

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION

3.01 PREPARATION

- A. Examine the areas and conditions under which excavating, filling, and grading are to be performed and notify the Resident Engineer in writing of conditions detrimental to the proper and timely completion of the work.

3.02 EXCAVATION AND TRENCHING

A. Trenching:

1. Excavation of trenches for conveyance piping and electrical conduits shall be excavated as shown on Drawings.
2. Trenches are to be excavated along alignment indicated on drawing or as directed by Resident Engineer.

B. Unauthorized Excavation:

1. There is to be no removal of materials beyond indicated limits or dimensions without specific direction of the Resident Engineer. No payment shall be given for unauthorized excavations.

3.03 COMPACTION

A. Percentage of Maximum Dry Density Requirements:

1. Provide not less than the following percentages of maximum dry density of soil material compacted at optimum moisture content, for the actual density of each layer of soil material-in-place.

- a. Unpaved Areas: Compact top 4 inches of subgrade and each 8-inch layer of backfill or fill material at 91 percent maximum density using a 6,000 lb. compaction roller.

3.04 BACKFILL

A. General:

1. Where backfill is required, the backfill will be free of large debris, including rocks and organic materials.

3.05 GRADING

A. General:

1. Uniformly grade areas within limits of grading under this section.
2. Smooth finish surface within specified tolerances, compact with uniform levels of slopes and existing grades.

END OF SECTION

SECTION 02613

PRESSURE PIPE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS: The general provisions of the Contract, including General Requirements apply to the work specified in this Section.

1.02 RELATED WORK SPECIFIED ELSEWHERE:

- A. Excavation, Backfill, and Compaction: Section 02221
- B. Field Testing of Pressure Pipe: Section 02651
- C. Piping and Valves: Section 15060

1.03 DESCRIPTION

- A. Work Included: Furnish and install the pipe materials and fittings of the types and sizes, and in the locations shown on the Drawings and as specified herein.
- B. The extent of the work is generally shown on the Drawings and shall be extended to accommodate changes which become necessary as a result of encountering unforeseen and changed conditions in the field.
- C. Above ground piping and valves and appurtenances are detailed in Section 15060.

1.04 SUBMITTALS

- A. Furnish the name of the manufacturer to the Contractor prior to commencing work. For any given material, use pipe of the same manufacturer throughout the project.
- B. The Contractor may request the Subcontractor to submit manufacturer's certification that the product meets requirements of the Specification.

1.05 QUALITY ASSURANCE: All materials shall conform to the standards designated in Part 2 for the appropriate material.

PART 2 - PRODUCTS

2.01 GENERAL

Subcontractor shall be responsible for all piping and appurtenances included with the conveyance system and including the well vault and treatment pad connections

as illustrated on drawing C-1 and C-2. Pipe sizes shall be as specified on the drawings.

A. HDPE Pipe

1. Standards:
 - a) Pipe: Classified as SDR-11 per ASTM F714
ASTM D3350 Cell Classification 345434C
2. All joints will be heat fused as per ASTM D3261
3. This pipe will be utilized for the recovered groundwater line from the recovery well and will be installed underground.

A. Polyvinyl chloride (PVC) Pressure Pipe

1. Standards:
 - a) Pipe: ANSI/American Water Works Association (AWWA) C900
 - b) Gaskets: ASTM F 477
2. Class: 200 (DR 14)
3. Use push-on joints with elastomeric gasket.
4. Use mechanical joint fittings for changes in direction.
5. This pipe will be utilized for aboveground applications for the recovered groundwater line from the recovery well.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. Install all pipe and fittings in strict accordance with the manufacturer's instructions and recommendations.
2. Install all pipes and fittings in accordance with the lines and grades shown on the Drawings and as required for a complete installation.
3. Install adapters, as required, when connecting pipes constructed of different materials.

B. Pipe Laying

1. Firmly support the pipe and fittings on the bottom of trenches as shown on the Drawings and as specified in the appropriate Sections of these Specifications.
2. Do not permanently support the pipe or fittings on saddles, blocking stones, or any material that does not provide firm and uniform bearing along the outside length of the pipe.
3. Thoroughly compact the material under the pipe to obtain a substantial unyielding bed shaped to fully support the pipe.
4. Excavate suitable holes for the joints so that only the barrel of the pipe receiving bearing pressure from the supporting material after placement.
5. Lay the pipe so it is level according to resident engineer.
6. Do not drive the pipe down to grade by striking it with a shovel handle, timber, rammer, or any other unyielding object.
7. When pipe length has been properly set, place and compact enough of the bedding material between the pipe and the sides of the trench to hold the pipe in correct alignment.
8. After filling the sides of the trench, place and lightly tamp bedding material to complete the bedding as shown on the Drawings.
9. Take all necessary precautions to prevent the floatation of the pipe in the trench.

C. Temporary Plugs

1. When pipe installation work in trenches is not in progress, close the open ends of the pipe with temporary watertight plugs.
2. If water is in the trench when work is resumed, do not remove plugs until all danger of water entering the pipe is eliminated.
3. Do not use the pipelines as conductors for trench drainage during construction.

D. Jointing

1. Connect pipe in accordance with the latest manufacturer's instructions and recommendations.

2. Clear each pipe length, coupling and fitting of all debris and dirt before installing.
3. Provide and use manufacturers specified equipment for jointing the pipe.
4. Shove home each length of PVC pipe into fittings and hold securely in position. Do not pull or cramp joints.
5. Make all pipe joints as watertight as possible with no visible leakage and no sand, silt, clay, or soil of any description entering the pipeline at the joints.
6. Immediately after making a joint, fill the holes for the joints with bedding material, and compact.

E. Pipe Cutting

1. Cut in accordance with manufacturer's recommendations.
2. Cut the pipe with a hand saw, metal-inserted abrasive wheel, or pipe cutter with blades (not rollers).
3. Examine all cut ends for possible cracks caused by cutting.

END OF SECTION

SECTION 02651

FIELD TESTING OF PRESSURE PIPE

PART 1 - GENERAL

1.01 **RELATED DOCUMENTS:** The general provisions of the Contract, including General Requirements apply to the work specified in this Section.

1.02 **RELATED WORK SPECIFIED ELSEWHERE**

- A. Excavation, Backfill, and Compaction: Section 02221
- B. Pressure Pipe: Section 02613

1.03 **DESCRIPTION**

- A. **Work Included:** Furnish all equipment and material and perform pressure tests as specified herein.

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION

3.01 **PRESSURE TESTING: ACCESSORIES FOR TESTING:** Subcontractor shall furnish and install the necessary pumps, pressure gauges, fittings, and accessories for attaching Subcontractor-furnished pressure gauges, pumps, etc. to be used in pressure tests. Water will be furnished by the Contractor. Supply water will be provided at the site. This equipment shall be connected to mains or plugs at points therein acceptable to the Contractor.

3.02 **GENERAL REQUIREMENTS:**

- A. Test procedures and method of disposal of water shall be approved by the Contractor. All tests shall be made in the presence of the Resident Engineer. Preliminary tests made by the Subcontractor without being observed by the Resident Engineer will not be accepted. Notify the Resident Engineer at least 24 hours before any work is to be inspected or tested.
- B. All defects in piping systems shall be repaired and/or replaced and retested until acceptable. Repairs shall be made to the standard of quality specified for the entire system.

- C. The piping system will be tested as one individual unit unless otherwise directed by the Resident Engineer.
 - D. All piping shall be tested in accordance with the following test methods, in addition to any test required by local and state codes or building authorities.
 - E. Fully inspect the installed piping for evidence of mechanical abuse and or suspect joints. Any damage found that reduces the pipe wall thickness by 10% or severe kinks (as determined by the Resident Engineer) should be cut out and the length of pipe reconnected per manufacturers specifications.
 - F. Prior to testing, flush all piping systems with water to remove construction debris.
 - G. Gauge dials shall be capable of reading a maximum of 120 psi with increments not to exceed 2 psi. Gauges capable of reading greater than 120 psi are not acceptable.
 - H. Should the pipe fail to meet the test requirements, re-excavate and repair at no cost to the Contractor.
- 3.03 **BACKFILL AND BLOCKING FOR PRESSURE PIPE:** After pressure pipe has been laid, it should be partially backfilled, but able to be observed along the entire length including joints. Where any section of the main is provided with concrete thrust blocking, the hydrostatic pressure test shall not be made until at least 5 days after the concrete is placed.
- 3.04 **PRESSURE TEST FOR PRESSURE PIPE**
- A. All force mains, process piping, water mains and services, and any other piping subject to pressure testing shall pass the following hydrostatic pressure test.
 - B. Tests for any exposed piping shall be made before covering and insulation is placed.
 - C. The pressure test for buried piping shall be made after all jointing operations are completed and any concrete reaction blocks and restraints have cured at least five days. Lines tested before backfill is in place shall be retested after compacted backfill is placed.
 - D. Sections of piping between valves and other short sections of line may be isolated for testing. If shorter sections are tested, test plugs or bulkheads required at the end of the test section shall be furnished and installed by the Subcontractor, together with all anchors, braces, and other devices required to withstand the hydrostatic pressure without imposing any thrust on the pipeline. The

Subcontractor shall be solely responsible for any damage that may result from the failure of test plugs or supports.

- E. Before joints are covered, each completed section of the pipeline shall be plugged at both ends and slowly filled with water. As the main is being filled with water in preparation for the hydrostatic pressure test, all air shall be expelled from the pipe through blow-offs, air reliefs, or temporary taps. All piping shall be subjected to hydrostatic pressure of 100 psi, +/- 2 psi maximum variation, or two times the operating pressure, whichever is greater, for a period of at least 2 hours. Pressure shall be applied to the piping by means of a hand pump. For the duration of the test, the lines shall be thoroughly inspected for leakage at all joints and elimination of leakage effected where necessary. Any cracked or defective pipes, joints, fittings, or valves discovered in consequence of the pressure test shall be removed and replaced by the Subcontractor at his own expense. All defects shall be remedied to the satisfaction of the Contractor. Tests will be continued until all visible leaks have been eliminated from the part of the system under test.
- F. After replacing or correcting cracked or defective pipe, fittings, etc. discovered in the pressure test, the Subcontractor shall re-test the pipe at his own expense.

END OF SECTION

DIVISION 11
EQUIPMENT

SECTION 11315

EXTRACTION WELL PUMP

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. Measurement and Payment: Section 01025
- B. Special Project Procedures: Section 01025
- C. Piping and Valves: Section 15050
- D. Electrical, General Provisions: Section 16010
- E. Electric Motors: Section 16150

1.02 DESCRIPTION

- A. Furnish and install one extraction well pump and all accessories at the location indicated on the Drawings and as specified herein.
- B. Equipment shall be designed for outdoor service.

1.03 QUALITY CONTROL

- A. Acceptable Manufacturers
 - 1. Grundfos - 209-292-8000.
- B. Pump Model
 - 1. Grundfos, 10S03-6 (1/3 horse power), 5 to 14 gallons per minute

1.04 SUBMITTALS

Three copies of each of the following shall be provided.

- A. Catalog Data: Manufacturer's literature and illustrations.
- B. Manufacturer's Specifications and Engineering Data.
- C. Performance Data.
- D. Shop Drawings.
- E. Operation and Maintenance Manuals.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Pump Construction

The following components shall all be 304 stainless steel.

1. Check valve and housing.
2. Diffuser chamber.
3. Impeller.
4. Inlet Screen.
5. Straps.
6. Cable guards.

B. Motors

C. Electrical Enclosures shall be NEMA 3R.

1. See schedule.
2. The motor design and quality shall meet the requirements of Section 16150 of these specifications.
3. Motors shall have a 1.15 service factor.
4. The pump curve shall be such that throughout the entire pump operating range, the brake horsepower required shall not exceed the motor rating.
5. Motors shall have normal-starting torque and low-starting current characteristics.
6. Designed for NEMA 3R service.
7. Motors shall operate on 120/240V, single phase.

PART 3 - EXECUTION

3.01 INSTALLATION

- #### A. Install all equipment in strict accordance with the manufacturer's recommendations, and make all adjustments required to provide complete and satisfactory operation.

- B. Before ordering any materials or doing any work, verify all measurements concerning equipment and layout.
- C. No extra compensation will be allowed for differences between actual dimensions and those shown on the Contract Drawings.

3.02 FIELD QUALITY CONTROL

- A. After installation of the pumping unit and appurtenances is complete, operating tests shall be carried out in the presence of the Contractor for a minimum of two hours.
- B. Each pumping unit shall be operated at its rated capacity.
- C. The Subcontractor shall provide an accurate and acceptable method for measuring discharge flow.
- D. Tests shall assure that the units and appurtenances have been installed correctly, and that there is no objectionable heating, vibration, or noise from any parts, and that all manual and automatic controls function properly.
- E. If any deficiencies are revealed during any tests, such deficiencies shall be corrected and the tests shall be reconducted.

END OF SECTION

DIVISION 15
MECHANICAL

SECTION 15060

PIPING AND VALVES

PART 1 GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

1.02 DESCRIPTION

- A. Furnish and install all above grade project piping and valves.

1.03 REFERENCES

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1. American Society of Mechanical Engineers (ASME)

1.04 SUBMITTALS

Three copies of each of the following shall be provided.

- A. Piping, Valves and Appurtenances.

1. Catalog Data: Manufacturer's literature and illustrations.
2. Manufacturer's Specifications and Engineering Data.

PART 2 PRODUCTS

2.01 MATERIALS

- A. General

1. All aboveground and well vault pipe shall be Schedule 80 PVC manufactured in accordance with ASTM D1785.
2. All valves utilized to regulate liquid flowstreams as well as provide 'on/off' service shall be globe type and are specified on the drawings.
3. All valves utilized for sampling ports shall be labcock ball valve type, PVC, 0.25" NPT with male thread and barb hose.

4. Globe valves shall be Schedule 80 PVC bodied, socket type and fitted with teflon seats and seals.
5. Check Valves are to be of the swing check type, socket connection, Schedule 80 PVC fitted with teflon seats and seals.
6. Ball valves shall be Schedule 80 PVC bodied and fitted with Viton "O" rings and brass, as specified on drawing.
7. Materials and components shall be in accordance with ASME B31.1, ASME specifications for PVC piping and all other applicable Federal, State, and Municipal Codes.

B. Piping Appertanances

1. In line pressure gauges shall be 0.25" NPT, 2" dial, liquid filled type with maximum pressure reading of 100 psi and 10 psi increments.
2. Flowmeters shall be instantaneous and totalizing, 1.5", Niagara liquid meters, model 123.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Fabricate, assemble and erect piping systems in accordance with ASME B31.1, and ASME specifications for PVC piping.
- B. General
 1. Install in a neat manner.
 2. Install to elevations shown on the Drawings.
 3. Piping Support: Provide support of piping per drawings.
 4. Accommodate thermal expansion and contraction of piping when supporting piping.
- C. All Horizontal Pipe Runs: Pitch to drain.
- D. Valve all branch lines as close to the junction with the main line as possible with the type of valve specified in the appropriate sections of Division 15.
- E. All Exterior Buried Piping: Install as required under Division 2.

- F. Make ample clearances and allowances for all expansion and contraction of piping.

3.02 PROTECTION OF EQUIPMENT

A. General

1. Exercise particular care during construction and start-up to prevent foreign materials from getting into the piping systems and lodging in valves, fittings, instrumentation or other equipment.
2. Temporarily block off equipment openings with solid diaphragms until after the piping systems have been cleaned and inspected.

B. Cleaning

1. Inspect the interior of all equipment to establish that it is free from dirt or other foreign matter prior to its connection with the piping system.
2. The Subcontractor shall be responsible for the repair of equipment damaged by passage of such dirt or foreign matter.

3.03 EXAMINATION

- A. Examine pressure piping system and components for leaks prior to start-up.
- B. Examination shall be performed by qualified and certified personnel.
- C. Repair or remove and replace all unacceptable defects or imperfections and re-examine.

END OF SECTION

DIVISION 16
ELECTRICAL REQUIREMENTS

SECTION 16010

ELECTRICAL, GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. Excavation, Backfill and Compaction: Section 02221

1.02 DESCRIPTION

- A. Work Included:

1. Furnish and install the complete additions to the electrical system detailed on the Drawings and as specified in this Section, including, but not limited to:
 - a. Electrical conduits and wiring.
 - b. Panel connections.
 - c. Boxes, receptacles, and plates.
 - d. Grounding of all conduit and equipment.
2. Secure and pay for all permits, inspections, tests, etc., as required by local, state, and Federal regulations.

1.03 QUALITY ASSURANCE

- A. Codes, Permits, and Inspection:

1. Manufacture, test, and install all work in accordance with applicable publications and standards of the following organizations:
 - American Society for Testing and Materials (ASTM)
 - Underwriters' Laboratories, Inc. (UL)
 - Insulated Cable Engineers Association (ICEA)
 - National Electrical Manufacturers Association (NEMA)
 - Institute of Electrical and Electronics Engineers (IEEE)
 - American National Standards Institute (ANSI)
 - National Fire Protection Association (NFPA)
 - Environmental Protection Agency (EPA)
 - State and Local Electrical Codes
 - National Board of Fire Underwriters

Occupational Safety and Health Administration (OSHA)
Electrical Testing Laboratory (ETL)

2. Comply with all laws applying to electrical installations in effect in this City, Town or State; with regulations of any other governmental body or agency having jurisdiction; with regulations of the National Electrical Code where such regulations do not conflict with those laws; and with the regulations of the Electrical Utility Company supplying electrical energy to the premises.
3. Electrical Subcontractor Responsibilities:
 - a. Obtain all permits required by the ordinances of City, Town, or State.
 - b. After completion of the work, furnish to the Engineer, for the Owner, a certificate of final inspection and approval from the Inspection Bureau having jurisdiction.
 - c. Perform and/or install all work in full compliance with all requirements of the Occupational Safety and Health Act of 1970 and all amendments thereto.

1.04 SUBMITTALS (not used)

1.05 COORDINATION, INTENT AND DISCREPANCIES

A. Intent:

1. The Drawings are intended to indicate only diagrammatically the extent, general character, and approximate locations of the work included.
2. Exact locations must be coordinated with local conditions and with other trades.
3. Work indicated but having minor details obviously omitted, shall be furnished complete to perform the functions intended without additional cost to the Owner.
4. Follow Drawings and this Section of the work fitted thereto.
5. All equipment shown on the Drawings is intended to be generally representative of the equipment which will be installed under this Contract, but it shall not be assumed that the Drawings indicate the specific configuration, arrangement or points of connection of the actual equipment which will be purchased.

6. The entire work provided for in this specification shall be constructed and finished in every respect in a proper and substantial manner, according to the accompanying Drawings and this specification.

B. Departure from the Contract Drawings:

1. Submit details of such departures and the reasons, therefore, as soon as practical, to the Contractor for approval.
2. No departures shall be made without signed approval of the Resident Engineer or his authorized agent.

C. Coordination:

1. The Subcontractor shall keep himself fully informed as to the size, shape, and location of all openings required for his pipes and apparatus and shall give full information to the other trades so that the openings may be built in advance.
2. It shall be the responsibility of the Subcontractor to pay all costs for sub-letting any work under this Section in order to avoid work stoppages due to jurisdictional disputes.
3. The Subcontractor shall confer with all other trades relative to the location of apparatus and equipment and select locations so as not to conflict with work of other trades.
4. Any conflict with other trades shall be referred immediately to the Engineer for resolution.
5. If interference occurs, the Resident Engineer will determine which work is to be relocated, regardless of which was first installed.

D. Discrepancies:

1. If the Subcontractor, in the course of the work, finds any discrepancies between Drawings or equipment listed and the physical conditions of the site, or any errors or omissions in dimensions or instructions given by Drawings or equipment lists, he shall immediately notify the Resident Engineer, in writing, and the Engineer shall promptly adjust the same.
2. Any work performed after such discovery, unless authorized by the Resident Engineer in writing, shall be at the Subcontractor's risk.
3. The Drawings are, in general, made to scale, but all measurements shall be taken from figured dimensions, and not by scaling.

4. Whether or not an error is believed to exist, deviations from the Drawings and dimensions given thereon shall be made only after written approval is received from the Resident Engineer.
5. The Subcontractor shall be responsible for comparing all Drawings and verifying all dimensions before laying out the work.
6. When measurements are affected by existing conditions, the Subcontractor shall take necessary field measurements and refer any differences in dimensions to the Resident Engineer.
7. Any and all errors in the work that might have been avoided by such field measurements shall be the responsibility of the Subcontractor.
8. When submitting proposal, give written notice to the Resident Engineer of any materials or apparatus in violation of laws, ordinances, rules or regulations of all authorities having jurisdiction, and notice of necessary items of work omitted.
9. If the Subcontractor fails to give such written notice, it shall be assumed that he has included cost of all items in his proposal, and he shall be held responsible for satisfactory functioning and approval of the entire installation without extra compensation.

1.06 TESTING

A. General:

1. Demonstrate by conducting a test that the additions to the electrical system function and perform as required to meet the needs of the Contractor, and in accordance with the Drawings and specifications.
2. Furnish personnel and calibrated instruments required for the tests. Owner shall furnish power.
3. Schedule tests at a time acceptable to the Subcontractor and Contractor.
4. Prior to applying voltage to any apparatus or circuit, make insulation resistance tests and, if necessary, dry the apparatus until resistance values conform to the standards of IEEE.
5. In drying out, use methods such that the insulation temperature of the apparatus does not exceed 90 deg.C.
6. In case of a low resistance circuit insulation, eliminate the problem before the circuit is energized.

7. Make a recheck after apparatus is dry.
8. Record all insulation values and furnish to the Engineer for review.
9. Prior to the start of check-out and testing, ensure that all equipment is properly and permanently identified.
10. Check screw and bolt connections and terminal connections for tightness prior to final tests and energization.
11. Provide 500 and 1000 V "megger" insulation testing during the construction and check-out period.
12. "Bump" 3 phase motors and reverse the connections as required to ensure proper rotation.
13. Test all main grounding loops and major equipment grounds to remote earth or directly referenced to an extremely low resistance (approximately 1 ohm) reference ground benchmark.
14. Record, witness, and report ground test results to the Owner's Representative.
15. Make tests with ground testing ohm meter or "megger."
16. Measure ground resistance of the individual networks at 2 points with cables at all the test points disconnected.
17. Reconnect the cables at the test points and make a duplicate set of ground resistance measurements.
18. Resistance shall not exceed 5 ohms.
19. Drive additional ground rods, if necessary.
20. Check all control circuits to see that their operation and sequence are correct.
21. Adjust any adjustable switches such as float switches, limit switches and timers for proper operation.
22. At no additional cost to the Contractor, promptly replace all electrical equipment, wiring, switches, insulators, etc., found to be defective or to have failed.

1.07 GUARANTEE

- A. The Subcontractor shall and does hereby warrant and guarantee that all work executed under this Section will be free from defects of materials and workmanship for a period of 1 year from the date of acceptance.
- B. The Subcontractor shall further warrant that all materials furnished and work executed are in accordance with all applicable laws and regulations.
- C. Subcontractor's guarantee for items furnished under Division 16 covers and includes:
 - 1. Faulty or inadequate design.
 - 2. Improper assembly or erection.
 - 3. Defective workmanship and materials.
 - 4. Leakage, breakage, or other failure.

END OF SECTION

SECTION 16050

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: Furnish and install basic electrical materials, including, but not limited to, conduit, wiring, fittings, and boxes as shown on the Drawings and as specified in this Section.

1.02 ACCEPTABLE MANUFACTURERS

A. Metallic Conduit:

1. Republic Steel Co.
2. Allied Tube & Cond. Corp.
3. Wheatland Tube Co.
4. National Electric Products
5. Or approved equal

B. PVC conduit.

1. R&G Sloane Mfg. Co.
2. Ashland Chemical Co.
3. Carlon
4. Or approved equal

C. Liquid Tight Flexible Metal Conduit:

1. Sealtite
2. Or approved equal

D. Copper Wire:

1. Pirelli
2. Okonite
3. Cablec
4. Rome Cable
5. Southwire
6. BIW
7. Or approved equal

E. Fittings, Boxes, Wall Cases, Plates, Bushings, Lock nuts, Hangers, Bars, and Related Equipment:

1. General Electric
2. O-Z Electrical
3. Raco
4. Steel City
5. Thomas & Betts
6. Gedney
7. Kindorf
8. Meyers
9. Or approved equal

F. Cast Fittings, Conduits, and Boxes for Exposed Work:

1. Appleton
2. Crouse-Hinds
3. Killark
4. Pyle-National
5. Or approved equal

PART 2 - PRODUCTS

2.01 MATERIAL

A. Exposed Conduit:

1. Rigid galvanized steel or PVC coated rigid aluminum heavy wall of standard trade size, per National Electrical Code or as specified on Drawings.
2. Each length shall have one coupling and a plastic thread protector, and shall bear the approval stamp of Underwriter's Laboratories.
3. Do not use conduit smaller than 3/4 in.

B. Embedded Conduit:

1. At least 3/4-in. diameter PVC and rigid or intermediate hot-dipped galvanized steel.
2. EMT not permitted.

- C. Underground Conduit: PVC electrical conduit with cemented joints allowed, meeting requirements of ASTM D 1785, ASTM D 2241, and ASTM F 512 or rigid or intermediate metal conduit or as direct burial cable.
- D. Liquid Tight Flexible Metal Conduit:
 - 1. Furnished with an oil-resistant, liquid tight PVC jacket in combination with flexible metal reinforcing tubing, and designated for use with waterproof fittings.
 - 2. Install an equipment bonding jumper for all liquid tight conduit up to and including 1-1/4 inch.
- E. Ensure that all conduit systems are electrically continuous.
- F. Wiring:
 - 1. As shown on the Drawings, or as required by the National Electric Code.
 - 2. Copper, Type XHHW, Type THWN
- G. Conduit Fittings:
 - 1. Form 8 Feraloy or Form 9 cast aluminum alloy with gasketed cover.
 - 2. Use PVC coated fittings with PVC coated conduit.
 - 3. Use fittings one size larger fitted with reducing bushings for 2-in. and larger.
- H. Outlet Boxes (Internal Volume Less than 100 cu. in.):
 - 1. Outdoors:
 - a. Use cast ferrous alloy or cast aluminum with internal threaded hubs and cast metal, gasketed covers.
 - b. Use boxes of the same material as conduit connected to them.
- I. Junction and Pull Boxes (Internal Volume Greater than 100 cu. in.):
 - 1. Outdoors or in Perpetually Wet Areas:
 - a. Fabricate boxes from aluminum or galvanized steel painted inside and out.
 - b. Use boxes of the same material as conduit connected to them.

- c. Use welded construction with screw-on, gasketed covers.
 - d. Make boxes rain tight when located outdoors.
 - e. Conduit Entry:
 - (1) Myers "Scru-tite" hubs or approved equal through field-punched holes; knockouts not acceptable.
 - (2) Enter through box bottom or sides wherever practical (not through top).
 - f. Furnish with ECD drain fitting in box bottom.
- J. Special Boxes: In corrosive areas, NEMA 4X, 316 SS.
- K. Bushings and Clamps:
- 1. Bushings:
 - a. Plastic insulating type for conduit 2-in. diameter and smaller.
 - b. Insulated metallic type for conduit over 2-in. diameter.
 - c. Ground Bushing: Insulated metallic type with set screw and large lug connecting screw.
 - 2. Clamps: Aluminum or galvanized malleable iron.
- L. Other Equipment, Lighting Fixtures and Special Devices Not Listed Above: Listed elsewhere in the Specifications, or indicated on the Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Conduit:
- 1. Cut conduits square, and ream cut ends carefully to remove burrs.
 - 2. Install with a minimum of bends or offsets.
 - 3. Use factory made bends for 1-in. trade size and larger.
 - 4. Field Fabricated Bends:
 - a. Free of indentations or elliptical sections due to improper fabrication.

- b. Make bends in metallic raceways while "cold." In no case heat raceways.
 - c. Bend raceways not more than 90 degrees.
 - d. Radius of Bends:
 - (1) Not less than required by the NEC.
 - (2) For groups of conduits, either concentric radii or equal radii bends may be used as long as the method used is consistent in any given area.
5. Use UL approved rain tight and concrete-tight connectors and couplings.
6. Protect terminations from mechanical injury and against entry of moisture and foreign matter into the conduit system by properly capping terminations.
7. Install exposed conduits parallel and group together where possible.
8. Support long "drops" of small conduit by structure or several drops tied together to provide rigid, straight, plumb and neat appearing installation.
9. Furnish and set in place all sleeves, etc., for exposed risers and inserts for raceway supports.
10. Use ells for the top bend of vertical conduit runs longer than 5 ft. In all cases cable rises shall be governed by Section 300-19 of the NEC.
11. Supports for Conduit Runs:
 - a. Conduit straps, pipe hangers or structural steel members.
 - b. Conduits of 1-1/2-in. diameter and less may be supported by 1-hole conduit straps on concrete, tile or steel work, but for larger size conduit, use 2-hole straps.
 - c. Use galvanized or aluminum Kindorf bar hangers as required for conduit supports.
 - d. In general, run conduit on top of Kindorf or other supports.
 - e. Use angle iron brackets for conduit supports around heavy vibration areas and extreme corrosive areas.

- f. Corrosive Areas: Use steel supports with a chemical resistant PVC coating.
 - g. Do not attach to or support by wooden plug anchors or mechanical work such as duct work and piping.
 - h. Use Kindorf hangers or angle iron brackets to support conduits grouped together.
 - i. Support horizontal and vertical runs of conduit at intervals of not more than 8 ft., except for conduit 1-in. or smaller, which shall be supported every 5 ft. Larger conduits in a rack may be used for this purpose.
 - j. Install stiffener supports on corners, offsets, and intermittently in runs to eliminate flexibility.
 - k. Standard Minimum Conduit Spacing: 3/4-in.
12. Perpetually Damp and Wet Locations:
- a. Prevent the contact of aluminum conduit with other heavy metals.
 - b. Separate iron clamps or hangers from the conduit by means of insulating tape or paint.
13. Use Meyers "Scrutite" watertight fittings or approved equal where conduits enter wall mounted control cabinets, safety switches, circuit breaker enclosure, motor control centers, or individual motor controllers not having threaded hubs.
14. Where conduit enters outlet boxes, pull-boxes or other enclosures not included in Subparagraph 17 above, use a double lock nut and bushing assembly.
15. Aluminum conduit shall not be installed in concrete.
16. Twisted tie wires are not adequate supports; approved clamps shall be used.
17. Provide continuous grounding between all outlets and established electrical ground system.
18. If non-metallic conduit is used, run a ground conductor in all conduits carrying power or lighting circuits.

19. Install explosion-proof fittings and use conduit seals in all hazardous areas and as noted on Drawings.
 20. Underground Conduit:
 - a. At least 24 in. below finished grade and at least 48 in. under road and pavement.
 21. Flexible Metal Conduit:
 - a. Use liquid-tight flexible conduit in all wet or damp locations.
 - b. Maximum length: 36 in., except that from outlet boxes to lighting fixture maximum length - 6 ft.
- B. Wire and Cable:
1. Conductor Sizes: As indicated on the Drawings but in no case smaller than indicated below:
 - a. Power circuits - #12 AWG
 - b. Lighting and receptacle circuits - #12 AWG
 - c. Control circuit wire for motor control - #14 AWG
 - d. Instrumentation - #16 AWG
 - e. Programmable controller I/O within panels - #16 AWG
 2. Stranded Wire and Cable Connections:
 - a. Make power cable connections for wire sizes #10 AWG and larger, where bolted terminations are utilized, with solderless tinned copper compression type connectors.
 - b. Connectors shall be formed high-conductivity copper, securely fastened with tools recommended by connector manufacturer, Burndy, or approved equal.
 3. Control Connections:
 - a. Make with compression-type fork tongue copper lugs with insulating sleeve.
 - b. T&B "Sta-Kon," or approved equal, T&B approved compression tool.
 4. Install wire and cable in conduit or other type raceway systems in accordance with the Drawings and the National Electrical Code.

5. Clean conduit of all foreign matter before wire is pulled in conduit or tray system.
6. Do not use mechanical means to pull conductors No. 8 or smaller.
7. Use of lubricants, other than talc powdered soapstone, or nonhardening compounds approved by the Underwriters' Laboratories and the cable manufacturer for pulling, is not permissible.
8. Provide suitable slack in wire or cable in boxes, outlets and cabinets to insure that there is no binding at the bushing.
9. Provide enough slack on motor leads in starter to permit the use of a "clamp-on" ammeter on any leg.
10. All wires shall be continuous, having no splices from terminal to terminal, unless otherwise indicated on the Drawings.
11. Identify all wire and cable, other than lighting branch circuits, at termination and splice points. Use the same wire number or circuit number as shown on the Drawings, wiring schedules, or connection diagrams. Identify all wires and cables with RayChem TMS wire marking system. Wire color shall conform with diagrams where noted.
12. Branch circuit wiring to outlets, receptacles, and fixtures shall conform strictly to the branch circuit numbers on each outlet on the Drawings.
13. Wiring Splice or Tap Insulation:
 - a. For 600 V insulated wire smaller than No. 8, use 3M Scotchlock and then apply 4 half laps of Scotch #88 plastic tape or approved equal.
 - b. For 600 V and less with wire sizes #8 AWG and larger, use compression terminators, 4 half laps of non-sticky varnish cambric tape, and 2 half laps of Scotch #88 tape or approved equal.
14. Make splices and terminations in cable rated at 600 V in accordance with the manufacturer's recommendations, using materials furnished by the cable manufacturer.
15. AC Motor Terminations:
 - a. Wire Sizes #10 AWG and Smaller: Use Scotchlock connection and 4 half laps of Scotch #88 tape or approved equal.

- b. Wire Sizes #8 AWG and Larger: Use compression terminators, 4 half laps of non-sticky varnish cambric tape, and 2 half laps of Scotch #88 tape or approved equal.
 - c. The above are minimum requirements. Apply additional taping where the above do not meet good practice or manufacturer's recommendations.
16. Wiring in Panelboards, Cabinets, etc:
- a. Neatly formed, grouped, and tied to provide a neat and orderly appearance in the cabinet.
 - b. Use plastic wiring duct where practical.
17. Use cast connections, Cadweld or Thermoweld, for ground conductors.
18. Make all splices and connections in accessible boxes and cabinets only.
19. On termination at branch circuit outlets, leave a minimum of 8-in. free conductor for installation of devices and fixtures.
20. Where feeder conductors pass through junction and pull boxes, bind and lace conductors of each feeder together.
21. For parallel sets of conductors, match lengths of conductors.
22. Bind together branch circuit conductors installed in panelboards, and control conductors installed in control cabinets and panels using "Ty-Raps" or equivalent.
23. Provide conduit seals and explosion-proof devices as indicated on the Drawings and as dictated by the National Electrical Code for all hazardous locations indicated on the Drawings.
24. In general, lighting shall be as located on the Drawings, however, where conflicts exists, locate lights for best distribution.
- C. Instrumentation and Low Level Signal and Control Wiring:
- 1. Install instrument transmission signal wiring as a Class 3 circuit under Article 725 of the National Electrical Code.
 - 2. Run signal cable in galvanized steel conduit.

3. Run instrument cables in conduit to be furnished and installed as specified in this Section and as indicated on the Drawings. Analog and digital signals will not be separated by barriers in the cable tray.
4. Shielded instrument analog and digital signal cables may be placed in the same tray or conduit.
5. Instrument transmission signal cable shield shall be carried continuously through to the designated panel where all shields shall be connected to a ground. Ground shields only at this point unless otherwise directed by instrument manufacturer's instructions, which shall be followed.

D. Outlet Boxes:

1. Consider location shown on Drawings as approximate only.
2. Locate outlet so that when fixtures, motors, cabinets, equipment, etc. are placed in position, outlet will serve its desired purpose.
3. Prior to installation, relocate any outlet location a distance of 5 ft. in any direction from location indicated on Drawings if so directed by the Engineer at no additional cost to the Owner.
4. Where outlets at different mounting heights are indicated on Drawings adjacent to each other (due to lack of physical space to show symbol on Drawings), install outlets on a common vertical line.
5. Size to accommodate the wiring device(s) to be installed.

E. Junction and Pull Boxes:

1. Install in readily accessible locations.
2. Do not block access to boxes by equipment, piping, ducts, and the like.
3. Provide all necessary junction or pull boxes required due to field conditions and as required by the National Electrical Code.

END OF SECTION

SECTION 16450

GROUNDING

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE:

- A. Electrical, General Requirements: Section 16010

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Size of Main Grounding Conductor: #2 bare stranded copper, minimum.
- B. Provide grounding conductors from ground electrodes to equipment as shown on the Drawings.
- C. Use 3/4 in. x 10 ft copperweld ground rods for direct burial.
- D. Do not use conduit as the ground and/or bonding conductor.
- E. Bond ground terminal of receptacles to ground conductor and outlet boxes with #12 AWG green insulated wire.
- F. Flexible metallic conduit suitable for grounding service.
- G. Ground conduit system and neutral conductor of wiring system with a connection at the main electrical service switchboard.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Make connections to ground rods with an exothermic welding process.
- B. Mechanical connections may be made at equipment only.
- C. Ensure that a ground loop is not formed between equipment ground in electrical conduit and grounding electrodes directly connected to ground electrodes.
- D. Equip exposed "pigtailed" or grounding electrodes with an armored sheath.

- E. Group and bond ground wires to panel boxes, light fixtures, receptacles, etc., not to system neutral.
- F. Ground Resistance Testing:
 - 1. Measure ground resistance with bridge type meter designed for testing grounds.
 - 2. Record readings, conditions of soil, model of meter, date, and name of tester.
 - 3. Conduct test in presence of Contractor. The test shall be made no less than 48 hours after a rain.
 - 4. Do not conceal conducting components until tested and accepted by Contractor.

END OF SECTION