



Oregon Institute of
Technology
Water Supply Improvements

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Technical
Specifications
For Bid



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FOR BID



TECHNICAL SPECIFICATION INDEX OIT Water Supply Improvements

DIVISION 1 GENERAL REQUIREMENTS

- 01010 Summary of Work**
- 01014 Work Sequence, Schedule, and Special Constraints**
- 01150 Measurement and Payment and Schedule of Values**
- 01200 Project Meetings**
- 01300 Submittals**
- 01311 CPM Construction Schedule**
- 01400 Quality Control**
- 01545 Protection and Maintenance of Work and Property**
- 01640 Owner Furnished Equipment**
- 01700 Project Closeout**
- 01720 Project Record Documents**

DIVISION 11 EQUIPMENT

- 11500 Chlorine Gas Injection System**
- 11600 MetaSys System**

DIVISION 15 GENERAL MECHANICAL

- 15020 General Mechanical Systems**

DIVISION 16 ELECTRICAL

- 16000 Electrical - General Provisions**
- 16120 Wire and Cable - 600 Volt and Below**
- 16130 Raceways, Boxes, Fittings and Supports**
- 16150 Panel boards**
- 16190 Dry-Type Transformers**
- 16450 Grounding**
- 16950 Acceptance Testing and Calibration**

DIVISION 01

SECTION 01010

SUMMARY OF WORK

PART 1 - GENERAL

1.1 The Requirement

- A. The work to be performed under this Contract shall consist of furnishing tools, equipment, materials, supplies, and manufactured articles, and furnishing all labor, transportation, and services, including fuel, power, water, and essential communications, and performing all work or other operations required for the fulfillment of the Contract Documents. The work shall be complete, and all work, materials, and services not expressly indicated or called for in the Contract Documents, which may be necessary for the complete and proper construction of the work in good faith, shall be provided by the CONTRACTOR as though originally so indicated at no increase in cost to the OWNER.

1.2 Work Covered by Contract Documents

- A. The work of this Contract consists of completing task at the relevant work stations in accordance with project Plans and Specifications:
1. Geothermal Building Control Room
 - a. Setup new screen for MetaSys water system monitoring.
 2. Storage Tank
 - a. Install new Ultrasonic Level meter.
 3. Well #1 Utility Building
 - a. Install Variable Frequency Drive for existing well pump. VFD equipment is supplied by OIT.
 - b. Install new 480V 3 Ph. Service Disconnect panel, including circuit disconnects for 480V 3 Ph VFD pump, one set of spare conductors for future projects, and 480V to 240/120V transformer.
 - c. Install new 480V to 240/120V transformer.
 - d. Install new 240/120V Load Center.
 - e. Install new Chlorine Gas injection system, including ½ HP water pump and piping, and connection to output signal from existing flow meter. Chlorine Gas injection system equipment is supplied by OIT.
 - f. Install new flex conduit for well pump wiring as shown on the plans.
 - g. Install MetaSys Digital Controls as shown on the Plans.
 - h. Install MetaSys wiring between Well #1 and Well #4 in ~~existing~~ 2" PVC conduit (Owner provided).
 - i. Install MetaSys wiring between Well #1 and Storage Tank in existing 2" PVC conduit.

1.3 Contractor Use Of Site

- A. The CONTRACTOR'S use of the Site shall be limited to its construction operations, including on-site storage of materials, on-site fabrication facilities, and field offices.
- B. The area needed for construction operations shall be approved by the OWNER prior to mobilization to the Site.

1.4 Owner Use Of the Site

- A. The OWNER will operate the existing treatment and irrigation system throughout the work. CONTRACTOR shall coordinate with the OWNER if the CONTRACTOR'S operation will cause a disruption in the operation of the existing facility. CONTRACTOR shall give the OWNER 48 hours notice prior to any disruption.
- B. In any event, the OWNER shall be allowed access to the Site during the period of construction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

DIVISION 01

SECTION 01014

WORK SEQUENCE, SCHEDULE AND SPECIAL CONSTRAINTS

PART 1 - GENERAL

1.1 Description

- A. This Section describes the CONTRACTOR'S responsibility with regard to scheduling, sequencing and completion of the work. It also describes additional constraints that must be considered in planning and execution of the work.

1.2 Contract Time And Schedule Of Construction

- A. Work may begin as soon as practical after award of bid.
- B. CONTRACTOR shall submit their detailed project schedule to the OWNER and ENGINEER at the pre-construction meeting to be held after award of contract. CONTRACTOR shall develop the project schedule per OUS General Conditions.
- C. All work on the balance of the contract shall be completed within 60 days after issuance of Notice to Proceed by OWNER.

1.3 Sequence, Schedule, and Work Constraints

- A. Work shall begin as soon as practical after award of bid but in time to meet the project complete date. A pre-construction conference will be held upon contract execution. If there is a delayed start, a second construction conference will be held within 1 week of actual construction start.
- B. The CONTRACTOR shall start work upon receiving the Notice to Proceed.
- C. Once started, work shall proceed in a continuous and orderly manner.
- D. All tie-ins to existing facilities shall be carefully coordinated with the OWNER and shall be performed at times acceptable to the OWNER. Provide 14 days advance written notification to the OWNER of proposed tie-in dates.

1.4 Work Hours

- A. Work hours shall comply with requirements as stated in OUS General Conditions.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

DIVISION 01

SECTION 01150

MEASUREMENT AND PAYMENT AND SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 Description

- A. Payment for the various items on the Bid Schedule, as further specified herein, shall include all compensation to be received by the CONTRACTOR for furnishing all tools, equipment, supplies, materials, and manufactured articles, and for all labor, operations, including incidentals; surveying, overhead and profit, etc. appurtenant to the items of work being described, as necessary to complete the various items of the work, in accepted operating condition, all in accordance with the requirements of the Contract Documents. Payment for the various items of the Bid Schedule shall also include all costs of compliance with the regulations of public agencies having jurisdiction, including Safety and Health Requirements of the Occupational Safety and Health Administration of the U.S. Department of Labor (OSHA). All costs shall be included in the price set forth in the Bid Schedule.

1.2 Progress Payments

- A. Progress payments shall be made monthly for work completed based on the Schedule of Values.

1.3 Schedule of Values

- A. Costs shall be for all items listed in the Contract Documents and all necessary installed appurtenances required for a working system.
- B. The CONTRACTOR shall submit a Preliminary Schedule of Values for the major components of the work during the Preconstruction Conference in accordance with Section 01200 - Project Meetings. The list shall include, at a minimum, a breakdown for the following major work components:
1. Plumbing
 2. Electrical
 3. Telecommunications, Cables, and Other Technologies

1.4 Revised Schedule of Values

- A. Following receipt of comments on the Preliminary Schedule of Values, the CONTRACTOR shall prepare and submit a revised Schedule of Values to the ENGINEER prior to the first progress payment. The Schedule of Values shall include units, unit costs, and subtotals for breakdown items. Because the ultimate requirement is to develop a detailed Schedule of Values sufficient to determine

appropriate monthly progress payment amounts, sufficient detailed breakdown shall be provided to meet this requirement. The ENGINEER shall be the sole judge of acceptable numbers, details and description of values established. If, in the opinion of the ENGINEER, a greater number of Schedule of Values items than proposed by the CONTRACTOR are necessary, the CONTRACTOR shall add the additional items so identified by the ENGINEER.

1.5 Changes To Schedule of Values

- A. Changes to the Schedule, which add activities not included in the original schedule but included in the original work (schedule omissions), shall have values assigned as approved by the ENGINEER. Other activities values shall be reduced to provide equal value adjustment increases for added activities as approved by the ENGINEER.
- B. In the event that the CONTRACTOR and ENGINEER agree to make adjustments to the original Schedule of Values because of inequities discovered in the original accepted detailed Schedule of Values, increases and equal decreases to values for activities may be made.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

DIVISION 01
SECTION 01200
PROJECT MEETINGS

PART 1 - GENERAL

1.1 Description

- A. This section covers the requirements for project meetings.
1. Meeting Records. The CONTRACTOR will record minutes of each meeting and will furnish copies to the ENGINEER within five working days thereafter. If the CONTRACTOR does not submit written objection to the contents of such minutes within seven days after presentation, it shall be understood and agreed that the CONTRACTOR accepts the minutes as a true and complete record of the meeting.
 2. Meeting Schedule. The dates, times, and locations for the various meetings shall be agreed upon and recorded at the pre-construction conference. Thereafter, changes to the schedule shall be by agreement between the OWNER and CONTRACTOR, with appropriate written notice to all parties involved.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 Preconstruction Conference

- A. Prior to issuance of the Notice to Proceed, a pre-construction conference shall be held at the location, date, and time designated by the OWNER.
1. Other attendees will be:
 - a. CONTRACTOR'S Project Manager, its superintendent, and its subcontractors as the CONTRACTOR deems appropriate
 - b. ENGINEER and the Resident Project Representative.
 - c. Representatives of OWNER.
 - d. Others as requested by CONTRACTOR, OWNER, or ENGINEER.
 2. Execution and Submittal of Documents. At the pre-construction conference, unless otherwise specified or agreed by the OWNER, the CONTRACTOR shall present to the OWNER a preliminary Schedule and all other preconstruction documents required of him as specified herein and those specified in Section 01300.

3. Agenda. In general, the matters to be discussed or resolved and the instructions and information to be furnished to or given by the CONTRACTOR at the preconstruction conference include but are not limited to:
 - a. Project meeting schedule.
 - b. Critical work sequencing.
 - c. Communication procedures between the parties.
 - d. The names and titles of all persons authorized by the CONTRACTOR to represent and execute documents for him, with samples of all authorized signatures.
 - e. The names, addresses, and telephone numbers of all those authorized by the CONTRACTOR to act for him in emergencies.
 - f. Construction permit requirements, procedures, and posting.
 - g. Public notice of starting work.
 - h. Access and rights-of-way furnished by the OWNER.
 - i. Forms and procedures for CONTRACTOR'S submittals.
 - j. Change order forms and procedures. Partial payment application forms and procedures.
 - k. Inspection staff and their duties.
 - l. Construction equipment and methods proposed by the CONTRACTOR.
 - m. Procedures for payroll and labor cost reporting by the CONTRACTOR and CONTRACTOR'S Schedule of Values.
 - n. Other administrative and general matters as needed.

3.2 Progress Meetings

- A. The CONTRACTOR shall attend, on-site progress meetings at times as requested by ENGINEER or as required by progress of the WORK. The CONTRACTOR, ENGINEER, and Subcontractors active on the site (as appropriate) must attend each meeting. CONTRACTOR may at its discretion request attendance by representatives of its Suppliers, manufacturers, and other Subcontractors.
- B. The CONTRACTOR shall preside at the meetings and will arrange for recording and distributing the minutes. All matters bearing on the progress and performance of the work since the preceding progress meeting shall be discussed and resolved, including, without limitation, any previously unresolved matters, deficiencies in the work or the methods being employed for the work, and problems, difficulties, or delays which may be encountered.

3.3 Special Meetings

- A. Upon appropriate notice to the other parties, special meetings may be called by the OWNER, ENGINEER, or CONTRACTOR. Special meetings will be held where and when designated by the OWNER.

3.4 Regulatory Agencies

- A. When requested, the CONTRACTOR shall attend meetings held or required by the governmental regulatory agencies having jurisdiction over the project.

END OF SECTION

DIVISION 01
SECTION 01300
SUBMITTALS

PART 1 - GENERAL

1.1 General

- A. This Section describes submittal requirements and forms a part of all technical sections of the Project Manual. Where the CONTRACTOR is required by these specifications to make submittals, they shall be made to the ENGINEER with a transmittal form (copies provided by ENGINEER).
- B. Before beginning the work, the CONTRACTOR shall submit a List of Materials to the ENGINEER for review. The List shall include all items of equipment and materials for mechanical, piping, electrical, equipment, instrumentation and plumbing work; and the names of proposed MANUFACTURERS and vendors. Items on the list shall be arranged in the same order as in these Specifications, and shall contain sufficient data to identify precisely the items of material and equipment the CONTRACTOR proposes to furnish. The list shall include the Specification or Drawing references. After the submission is favorably reviewed and returned to the CONTRACTOR by the ENGINEER, it shall become the basis for the submission of detailed MANUFACTURER'S drawings, catalog cuts, curves, diagrams, schematics, data, and information on each separate item for review by the ENGINEER as set forth in this Section.

1.2 Preconstruction Conference Submittals

- A. At the preconstruction conference referred to in Section 01200 - Project Meetings, the CONTRACTOR shall submit the following items to the ENGINEER for review:
 - 1. A preliminary schedule of Shop Drawings, Samples, and proposed Substitute ("Or-Equal") submittals.
 - 2. A list of all permits and licenses the CONTRACTOR shall obtain indicating the agency required to grant the permit, the expected date of submittal for the permit, and required date for receipt of the permit.
 - 3. A preliminary Schedule of Values in accordance with Section 01150 - Measurement and Payment and Schedule of Values.
 - 4. A preliminary project schedule, meeting the requirements of Section 01311.

1.3 Shop Drawings

- A. Wherever called for in the Contract Documents, or where required by the ENGINEER, the CONTRACTOR shall furnish to the ENGINEER three (3) copies of each submittal for review. The term "Shop Drawings," as used herein, shall be

understood to include fabrication, erection and installation drawings, with supporting list, graphs, catalog sheets, data sheets, and similar items. Whenever the CONTRACTOR is required to submit design calculations as part of a submittal, such calculations shall bear the signature and seal of an engineer registered in the appropriate branch and in the state wherein the project is to be built, unless otherwise directed.

- B. All Shop Drawing submittals shall be accompanied by a transmittal form. Any submittal not accompanied by such a form, or where all applicable items on the form are not completed, will be returned for re-submittal.
- C. Normally, a separate transmittal form shall be used for each specific item or class of material or equipment for which a submittal is required. Transmittal of a submittal of various items using a single transmittal form will be permitted only when the items taken together constitute a MANUFACTURER'S "package" or are so functionally related that expediency indicates review of the group or package as a whole. A multiple-page submittal shall be collated into sets, and each set shall be stapled or bound, as appropriate, prior to transmittal to the ENGINEER.
- D. Except as may otherwise be indicated herein, the ENGINEER will return prints of each submittal to the CONTRACTOR with its comments noted thereon. It is considered reasonable that the CONTRACTOR shall make a complete and acceptable submittal to the ENGINEER by the second submission of a submittal item. The OWNER reserves the right to withhold monies due to the CONTRACTOR to cover additional costs of the ENGINEER'S review beyond the second submittal. The ENGINEER'S maximum review period for each submittal will be 30 days per submittal. If two (2) copies of a submittal are returned to the CONTRACTOR marked "NO EXCEPTIONS TAKEN," formal revision and resubmission of said submittal will not be required.
- E. If two (2) copies of a submittal are returned to the CONTRACTOR marked "MAKE CORRECTIONS NOTED," formal revision and resubmission of said submittal will not be required.
- F. If a submittal is returned to the CONTRACTOR marked "AMEND-RESUBMIT," the CONTRACTOR shall revise said submittal and shall resubmit the required number of copies of said revised submittal to the ENGINEER.
- G. Each submittal shall be dated, signed, and certified by the CONTRACTOR, as being correct. No consideration for review by the ENGINEER of any CONTRACTOR submittals will be made for any items which have not been so certified by the CONTRACTOR. All non-certified submittals will be returned to the CONTRACTOR without action taken by the ENGINEER, and any delays caused thereby shall be the total responsibility of the CONTRACTOR.
- H. The CONTRACTOR shall refer to the Execution part of this section for additional requirements pertaining to project submittals, etc.

1.4 Supplier Data

- A. Include on each shop drawing and material submittal the name, address, contact person, and telephone number of each supplier.

1.5 Contractor's Schedule

- A. The CONTRACTOR'S construction schedules and reports shall be prepared and submitted to the ENGINEER in accordance with the provisions of Section 01311.

1.6 Operation and Maintenance (O&M) Manuals

- A. General: Where specified herein, operation and maintenance information shall be provided and shall consist of the names and addresses of the MANUFACTURER, the nearest representative of the MANUFACTURER, and the nearest supplier of the MANUFACTURER'S equipment and parts.
- B. The CONTRACTOR shall submit technical operation and maintenance information for each item of mechanical, electrical and instrumentation equipment in an organized manner in the O&M Manual. It shall be written so that it can be used and understood by the OWNER'S operation and maintenance staff.
- C. The CONTRACTOR shall furnish to the ENGINEER, three (3) identical O&M Manuals for each item or group of items. Each set shall consist of one or more volumes, each of which shall be bound in a standard size, 3-ring, loose-leaf, vinyl plastic hard cover binder suitable for bookshelf storage. Binders shall have clear slip-in windows on front and spine for labeling. Binder ring size shall not exceed 2.5-inches. A table of contents indicating all equipment in the manuals shall be prepared. Labeled section dividers shall be used to delineate various pieces of equipment.
- D. O&M Manuals shall be submitted in final form to the ENGINEER not later than the 75 percent of construction completion date. All discrepancies found by the ENGINEER in the O&M Manuals shall be corrected by the CONTRACTOR within 30 days from the date of written notification by the ENGINEER.
- E. Incomplete or unacceptable O&M Manuals at the 75 percent construction completion point shall constitute sufficient justification to withhold progress payments for same.

1.7 Spare Parts List

- A. The CONTRACTOR shall furnish to the ENGINEER, three (3) identical sets of spare parts information for all mechanical, electrical, and instrumentation equipment. The spare parts list shall include the current list price of each spare part. The spare parts list shall be limited to those spare parts that each MANUFACTURER recommends be maintained by the OWNER in inventory at the plant site. Each MANUFACTURER or supplier shall indicate the name, address, and telephone number of its nearest outlet of spare parts to facilitate the OWNER in ordering. The CONTRACTOR shall cross-reference all spare parts lists to the

equipment numbers designated in the Contract Documents. The spare parts lists shall be bound in standard size, 3-ring, loose-leaf, vinyl plastic hard cover binders suitable for bookshelf storage. Labeled section dividers shall be used to delineate various pieces of equipment. Binder ring size shall not exceed 2.5 inches.

1.8 Record Drawings

- A. The CONTRACTOR shall keep and maintain, at the job site, one record set of Drawings. On the Drawings, it shall mark all project conditions, locations, configurations, and any other changes or deviations that may vary from the details represented on the original Contract Drawings, including buried or concealed construction and utility features, which are revealed during the course of construction. Special attention shall be given to recording the horizontal and vertical location of all buried utilities that differ from the locations indicated or that were not indicated on the Contract Drawings. Said record drawings shall be supplemented by any detailed sketches as necessary or directed to indicate, fully, the work as actually constructed. These master record drawings of the CONTRACTOR'S representation of as-built conditions, including all revisions made necessary by addenda and change orders shall be maintained up-to-date during the progress of the work.
- B. Record drawings shall be accessible to the ENGINEER at all times during the construction period.
- C. Final payment will not be acted upon until the CONTRACTOR prepared record drawings have been delivered to the ENGINEER. Said up-to-date record drawings shall be in the form of a set of prints with carefully plotted information overlaid in red.
- D. Upon substantial completion of the work and prior to final acceptance, the CONTRACTOR shall finalize and deliver a complete set of record drawings to the OWNER, conforming to the construction records of the CONTRACTOR. This set of drawings shall consist of corrected drawings showing the reported location of the work. The information submitted by the CONTRACTOR and incorporated by the ENGINEER into the Record Drawings will be assumed to be correct and the CONTRACTOR shall be responsible for the accuracy of such information and any errors or omissions, which may appear on the Record Drawings as a result.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 Designation of Superintendent

- A. The CONTRACTOR shall designate in writing, before starting work, an authorized representative who shall have complete authority to represent and to act for the CONTRACTOR. Said authorized representative shall be present at the site of the

work at all times while work is actually in progress on the contract and during periods when work is suspended. Arrangements acceptable to the OWNER shall be made for any emergency work, which may be required.

- B. When the CONTRACTOR consists of two or more persons, firms, partnerships, or corporations functioning on a joint venture basis, said CONTRACTOR shall designate in writing to the OWNER, the name of their authorized representatives who shall have supreme authority to direct the work and to whom orders will be given by the OWNER and ENGINEER, to be received and obeyed by the CONTRACTOR.
- C. The representative shall not be replaced without the OWNER'S knowledge.

3.2 Shop Drawings

- A. The CONTRACTOR shall submit, at its own expense, those shop drawings, coordination drawings, and other submittal data required by the technical specifications. The favorable review of submittal drawings by the ENGINEER shall apply in general design only and shall in no way relieve the CONTRACTOR from responsibility for errors or omissions contained therein. Favorable review shall not relieve the CONTRACTOR of its obligation to meet safety requirements and all other requirements of laws, nor constitute a Contract Change Order.
- B. All submissions shall be completed within ninety (90) days after the award of contract.

3.3 Construction Schedule

- A. The CONTRACTOR'S construction schedule shall be prepared and submitted to the ENGINEER in accordance with the provisions of Section 01311 - CPM Construction Schedule.

END OF SECTION

DIVISION 01

SECTION 01311

CPM CONSTRUCTION SCHEDULE

PART 1 - GENERAL

1.1 The Requirement

- A. The project management scheduling tool “Critical Path Method,” commonly called CPM, shall be employed by the CONTRACTOR for the planning and scheduling of all work required under the Contract Documents. Alternately, CONTRACTOR proposed scheduling tools, such as Microsoft Project or approved equivalent will be reviewed for acceptance.

1.2 Submittal Procedures

- A. Time of Submittals: At the Preconstruction Conference, the CONTRACTOR shall submit to the OWNER, three (3) bound copies of the CPM Construction Schedule and CPM network diagram describing the activities to be accomplished in the project and their dependency relationships, including the dates when each part of the work will be started and completed. The schedule produced and submitted shall conform to the calendar days and construction completion date set forth herein for completion of the work and shall be subject to modification by the OWNER. The OWNER and ENGINEER shall review the CPM Construction Schedule with the CONTRACTOR, and the CONTRACTOR shall revise the CPM Construction Schedule as required. The CPM Construction Schedule shall indicate all construction activities, sub-activities and mileposts on a time-oriented basis. The CPM Construction Schedule shall be prepared using Microsoft Project or approved equal. The critical path shall be fully identified.
1. At a minimum, the following activities shall be detailed in the CPM Construction Schedule:
 - a. Shop drawing submittals
 - b. Ordering and delivery dates for long lead-time items
 - c. Start work and mobilization
 - d. Punch list
 - e. Final completion
 2. The CPM Construction Schedule shall clearly indicate the order in which the work is scheduled to be built and the date that construction on each item is to begin. The starting and ending dates for construction on each item shall also be shown.

- B. Schedule Revisions: The CONTRACTOR shall modify any portions of the CPM Construction Schedule that become unfeasible because of “activities behind schedule” or for any other valid reason. An activity that cannot be completed by its original latest completion date shall be deemed behind schedule.
 - 1. A revised CPM Construction Schedule, showing all slippages and missed mileposts, shall be submitted whenever work on critical path items falls ten (10) or more days behind schedule.
- C. The favorably reviewed project schedule and its revisions will be used by the OWNER to coordinate inspection work, and any changes in the schedule shall provide ample time for the OWNER to reschedule inspection work. Delays caused by CONTRACTOR-initiated changes in the schedule or the CONTRACTOR’S failure to follow the progress schedule shall not be the basis for claims against the OWNER.
- D. A preliminary version of the CPM Construction Schedule shall be submitted to the OWNER at the pre-construction conference.
- E. No progress payments will be made until the CPM Construction Schedule is completed and revised to the satisfaction of the OWNER.

1.3 Change Orders

- A. Upon approval of a change order, the approved change shall be reflected in the next submittal of the CPM Construction Schedule by the CONTRACTOR.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

DIVISION 01
SECTION 01400
QUALITY CONTROL

PART 1 - GENERAL

1.1 Description

- A. This section covers quality control requirements supplementary to those of the General Conditions and Technical Specifications.

1.2 Provisions

- A. The CONTRACTOR shall provide safe access for the ENGINEER and its inspectors to adequately inspect the quality of work and the conformance with project specifications. The CONTRACTOR shall provide adequate lighting, ventilation, ladders, and other protective facilities as may be necessary for the safe performance of inspections.
- B. Inspections, tests or favorable reviews by the ENGINEER shall not relieve the CONTRACTOR from its obligations to perform the work in accordance with the requirements of the Contract Documents.
- C. Work covered without the favorable review or consent of the ENGINEER shall be uncovered for examination at the CONTRACTOR'S expense.
- D. If the ENGINEER considers it necessary or advisable that covered work be inspected or tested by others, the CONTRACTOR shall uncover, expose, or otherwise make available for observation, inspection or testing, that portion of the work in question, furnishing all necessary labor, materials, tools, and equipment. If it is found that work, which has been covered, is defective, the CONTRACTOR will bear all the expenses of such uncovering, exposure, observation, inspection and testing and of satisfactory reconstruction. Only if such work is not found to be defective and was covered with the consent of the ENGINEER, will the CONTRACTOR be allowed an increase in the contract price or an extension of the contract time, or both, directly attributable to such uncovering, exposure, observation, inspection, testing and reconstruction, and an appropriate change order shall be issued.
- E. Whenever the CONTRACTOR varies the period during which work is carried on each day, the CONTRACTOR shall give due notice to the ENGINEER so that proper inspection may be provided. Any work done in the absence of the ENGINEER or OWNER's representative shall be subject to rejection. Proper facilities for safe access for inspection to all parts of the work shall at all times be maintained for the necessary use of the ENGINEER. Authorized representatives and agents of the ENGINEER shall be permitted access to inspect all work and

materials wherever it is required for preparation of progress reports, and the CONTRACTOR shall provide proper facilities for such access and inspection. Records shall be available at all reasonable hours for inspection by the ENGINEER to ascertain compliance with laws and regulations.

1.3 Quality Assurance

A. Tests

1. General

- a. Where the Specifications require work to be specifically tested or approved, it shall be tested in the presence of the ENGINEER after timely notice of its readiness for inspection and testing, and the work, after testing, shall be covered up only with the consent of the ENGINEER.
- b. The results of any tests made are for the information of the ENGINEER. Regardless of any test results, the CONTRACTOR is solely responsible for the quality of workmanship and materials and for compliance with the requirements of the Drawings and Specifications.
- c. Except as specifically required under detail materials specifications for shop testing and inspection, all tests of materials furnished by the CONTRACTOR will be made in the presence of the ENGINEER in accordance with the commonly recognized standards of national organizations. The CONTRACTOR shall furnish such samples of all materials as required by the Contract Documents without charge. No material shall be used unless it has been favorably reviewed by the ENGINEER.
- d. Where such inspection and testing are to be conducted by an independent laboratory or agency, the sample or samples of materials to be tested shall be selected by such laboratory or agency or the ENGINEER and not by the CONTRACTOR.

2. Costs of Testing and Inspection

- a. The CONTRACTOR shall be responsible for and shall pay for on-site and off-site tests of materials and equipment required except those specifically noted otherwise. The ENGINEER shall have the right to witness all off-site tests, and the CONTRACTOR shall furnish adequate notice of when tests will be made.
- b. When, in the opinion of the ENGINEER, additional tests or inspections are required because of the manner in which the CONTRACTOR executes its work, such additional costs therefore will be paid for by the ENGINEER, but will be deducted from the contract price. Examples of such additional tests and inspections are tests of materials substituted for previously accepted materials or substituted for specified materials or retests made necessary by failure of material to comply with the requirements of the Specifications.

- c. All piping shall be tested for tightness, specifically as required in the technical sections of this Specification or as shown on schedules on the Drawings.
- d. The CONTRACTOR shall be responsible for and shall pay costs of special inspection services where designated in the specifications.

1.4 Submittals

A. Inspection Reports

- 1. Each report shall be signed and certified by the supervising representative. Unless otherwise specified, submit five (5) copies of each report to the ENGINEER.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

DIVISION 01

SECTION 01545

PROTECTION AND MAINTENANCE OF WORK AND PROPERTY

PART 1 - GENERAL

1.1 Description

- A. This section sets forth CONTRACTOR responsibilities for protection and maintenance of work and property.

1.2 Public and Private Property

- A. The CONTRACTOR shall protect and maintain all underground or above ground utilities and structures affected by the work and all lawns, shrubs, trees, fences, rockeries, etc., and parking strips or private property crossed by or adjacent to its operation, and any damage shall be repaired and restored by the CONTRACTOR to the satisfaction of the OWNER.
- B. The CONTRACTOR will be responsible for all damage to roads, highways, ditches, bulkheads, walls, bridges, culverts, utilities, barricades, lights, or other property, caused by the work, whether such damage be at the site of the work or caused by transporting or hauling to or from the work. The CONTRACTOR shall repair or replace, or arrange for the repair or replacement, of all such damage to the satisfaction of the OWNER. Any material damaged by the CONTRACTOR'S operations shall be replaced with new material.
- C. Whenever construction work under this Contract is undertaken on easement, right-of-way, or franchise, all work shall be confined to the limits of such easement, right-of-way, or franchise and accomplished so as to cause the least amount of disturbance and the minimum amount of damage.
- D. It is expressly understood that the CONTRACTOR shall, in particular, restore all easements and rights-of-way to a condition equal to their original condition and in a condition satisfactory to the property owners and the OWNER.

1.3 Care of Existing Facilities

- A. The CONTRACTOR shall take adequate precautions to protect existing sidewalks, curbs, pavements, utilities, adjoining property, and structures, and to avoid damage thereto, and shall, at its own expense, completely repair any damage thereto caused by its operation.

1.4 Emergencies

- A. Whenever the CONTRACTOR'S work endangers the safety of life or property, including adjoining property or property in the immediate proximity of the project,

the CONTRACTOR shall take all reasonable precautions to prevent threatened loss or injury there from and shall be solely responsible for any damages or injury occurring. Access for emergency vehicles and fire fighting equipment shall be provided at all times.

1.5 Utility Notification and Protection

- A. Forty-eight (48) hours prior to beginning any underground excavation one foot or more in depth, the CONTRACTOR shall notify Utilities Underground Location Center for location and marking of existing utilities, and OWNER to locate utilities within property boundaries.
- B. The exact location of underground facilities and improvements within the construction area shall be ascertained by the CONTRACTOR by exploratory “potholing” before using equipment that may damage such facilities or interfere with their service.
- C. The CONTRACTOR shall uncover (“pothole”) all piping to a point one foot below the pipe where crossings, interferences, or connections are shown on the Drawings prior to trenching or excavating for any pipe or structures to determine actual elevations. New pipelines shall be laid to such grade as to clear all existing facilities, which are to remain in service for any period subsequent to the construction of the run of pipe involved. Excavations around underground electrical ducts, conduits, and high pressure gas lines shall be performed using extreme caution to prevent injury or damage to workers and to the electrical ducts, conduits and high pressure gas lines.
- D. If interferences occur at locations other than shown or referred to on the Drawings, the CONTRACTOR shall notify the OWNER and a method for correcting said interference will be supplied by the OWNER. Payment for work required to eliminate interferences not shown on the Drawings will be in accordance with the provisions of the Contract Documents.

PART 2 - PRODUCTS (Not applicable to this section.)

PART 3 - EXECUTION (Not applicable to this section.)

END OF SECTION

DIVISION 01

SECTION 01640

OWNER FURNISHED EQUIPMENT

PART 1 - GENERAL

1.1 Summary

A. This section includes OWNER furnished equipment.

1.2 Responsibilities for OWNER Furnished Equipment

A. Product Delivery: Product supplier will deliver products to jobsite for CONTRACTOR to receive on delivery date established by CONTRACTOR. After Award of Contract, OWNER and CONTRACTOR will contact supplier to establish a product delivery and installation date, quantities of materials, and a coordination procedure.

B. Owner Responsibilities:

1. Responsibilities by OWNER shall correspond to the party furnishing the product as specified hereinafter.
2. Arrange for delivery of supplier furnished shop drawings, product data, samples, and installation instructions to CONTRACTOR.
 - a. Deliver supplier's shipment list of materials to CONTRACTOR.
 - b. Submit claims for transportation damage.
 - c. Arrange for replacement of damaged, defective, or missing items.
 - d. Arrange for MANUFACTURERS' warranties, bonds, services, and inspections, as required.

C. Contractor Responsibilities:

1. Review supplier furnished shop drawings, product data, and samples under provisions of Section 01300.
2. Submit to supplier, with notification to ENGINEER and OWNER, any discrepancies or problems anticipated in the use the products.
3. Receive and unload products at the Site.
4. Verify quantity of products furnished with shop drawings, Final Field Use Drawings, or Bills of Material as applicable.
5. Promptly inspect products upon receipt for shortages, damaged, or defective items and report to OWNER. Upon notification, OWNER will arrange for delivery of replacement products.

6. Handle products at site, including uncrating, storage, and protection.
7. Install products in accordance to MANUFACTURERS' recommendations.
8. Protect installed products from damage.
9. Replace items damaged by CONTRACTOR.
10. Remove trash, debris, and rubbish.
11. Manufacturing Defects: Report suspected product manufacturing defects to OWNER and ENGINEER. Upon notification, OWNER will arrange for repair of product manufacturing defects.

1.3 Contractor Installation of Owner Furnished Equipment

- A. Install in accordance with MANUFACTURER'S instructions.
- B. Work in harmony with all subcontractors, suppliers and MANUFACTURERS.
- C. Unpack and set in place, plumb, level, and secure.
- D. Connect to mechanical, plumbing, and electrical systems as required.
- E. Remove packaging and clean products.
- F. Test and adjust as required.
- G. Unless otherwise specified, CONTRACTOR shall coordinate delivery date of OWNER furnished equipment.

PART 2 - PRODUCTS

- A. Products Furnished by OWNER
 - a. Danfoss VLT 6000 HVAC Variable Frequency Drive, Serial No. 215000Y366, 460 VAC, 106 A.
 - b. V10KR Wallace & Tiernan Flow Proportional Controls. Actuator, 115 Volt; SFC-SC Controller; Flow paced V-notch plug assembly.
 - c. Other Existing Equipment on site and/or shown on drawings

PART 3 - EXECUTION (Not Used)

END OF SECTION

DIVISION 1
SECTION 01700
PROJECT CLOSEOUT

PART 1 - GENERAL

1.1 Final Cleanup

- A. The CONTRACTOR shall promptly remove from the vicinity of the completed work, all rubbish, unused materials, concrete forms, construction equipment, and temporary structures and facilities used during construction. Final acceptance of the WORK by the OWNER will be withheld until the CONTRACTOR has satisfactorily complied with the foregoing requirements for final cleanup of the project site.

1.2 Final Submittals

- A. The CONTRACTOR, prior to requesting final payment, shall obtain and submit the following items to the ENGINEER for transmittal to the OWNER:
1. Written guarantees, where required.
 2. Finalized O&M Manuals and instructions.
 3. Maintenance stock items; spare parts; special tools.
 4. Completed record drawings.
 5. Certificates of inspection and acceptance by local governing agencies having jurisdiction.

1.3 Maintenance and Guarantee

- A. The CONTRACTOR shall comply with the maintenance and guarantee requirements of the General Conditions and individual equipment specifications.
- B. The CONTRACTOR shall make all repairs and replacements promptly upon receipt of written order from the OWNER. If the CONTRACTOR fails to make such repairs or replacements promptly, the OWNER reserves the right to do the WORK and the CONTRACTOR and his surety shall be liable to the OWNER for the cost thereof.

END OF SECTION

DIVISION 01
SECTION 01720
PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 Maintenance Of Documents

- A. The CONTRACTOR shall maintain at job site, one copy each of:
 - 1. Contract Drawings.
 - 2. Addenda.
 - 3. Reviewed Shop Drawings.
 - 4. Change Orders.
- B. Store documents in field office, apart from documents used for construction.
- C. Maintain documents in clean, dry, legible condition.
- D. Make documents available at all times for inspection by ENGINEER and OWNER.

1.2 Products

- A. Mark record changes in red pencil on the drawings.
- B. Progress payments may not be made if the record drawings are not current.

PART 2 - PRODUCTS

2.1 Field Construction Records:

- A. The CONTRACTOR shall maintain an accurate, up to date, record of all field construction. These records shall include all construction information and any changes to the contract documents and shall be provided to OWNER as required by OWNER and in no event later than at the time of OWNER'S final acceptance of the project work.

PART 3 - EXECUTION

3.1 Record Drawings:

- A. The CONTRACTOR shall maintain, on the jobsite, a paper copy of project field plans marked to indicate OWNER-approved plan revisions made in the field and other details of construction.
- B. Construction Details: The record drawings shall show details of construction, including, but not be limited to:
 - 1. Fittings: Any changes to the fitting callouts on the design plans shall be noted.
 - 2. Pipe Routing Revisions: Show any deviations from alignment, routings, and grades of piping systems.
 - 3. Electrical, mechanical, and instrumentation system modifications.
 - 4. All approved changes to the plans shall be noted.

END OF SECTION

DIVISION 11

SECTION 11500

CHLORINE GAS INJECTION SYSTEM

PART 1 - GENERAL

1.1 Description Of Work

- A. The CONTRACTOR will upgrade the existing gas chlorine injection system with a new pressure boost water pump for chlorine gas injection, including a proportional flow controller, plumbing, and wiring necessary to supply a completed system.
- B. In addition to the requirements of these specifications, the quality assurance shall comply with the MANUFACTURER'S instructions and recommendations for work.
- C. These Specifications are intended to give a general description of what is required, but do not cover all details, which will vary in accordance with the requirements of the desired equipment application.
- D. OIT shall purchase and supply Chlorination Equipment supplied by Engineered Control Products, as noted in Section 2.1.

1.2 References and Standards

- A. The design, fabrication, manufacturing and assembly of the equipment as specified herein shall be in conformance with the standards of the organizations listed below. Where reference is made to a standard of one of the following or other organizations, the version of the standard in effect at the time of the bid opening shall apply.
 - 1. ASTM – American Society of Testing Materials
 - 2. ASME – American Society of Mechanical Engineers
 - 3. AWWA – American Water Works Association
 - 4. IEEE – Institute of Electrical and Electronics Engineers
 - 5. NEC – National Electrical Code
 - 6. NEMA – National Electrical Manufacturer's Association
 - 7. OSHA – Occupational Safety and Health Administration

1.3 Quality Assurance and Qualifications

- A. To guarantee unity of responsibility, the specified equipment shall be provided and coordinated by the MANUFACTURER. The CONTRACTOR shall assume full responsibility for the satisfactory operation of the equipment.

1.4 Submittals

- A. Related Documents: copies of all materials required, establishing compliance with the Specifications, shall be submitted in accordance with the provisions of the proposed equipment. The submittal format shall be in the form of a booklet, suitably tabbed and divided to cover at least the areas noted below for each major equipment item. The submittal booklet shall include adequate detail and sufficient information for the ENGINEER to determine that all of the equipment proposed meets the detailed requirements of the Specifications. Incomplete or partial submittals will not be reviewed. Submittals shall include at least the following:
 - 1. Certified shop and skid drawings showing all important details of construction, dimensions and anchor bolt locations.
 - 2. Descriptive brochure and literature, bulletins and/or catalogs of the equipment.
 - 3. A complete bill of materials of all equipment. This may be furnished with Operation and Maintenance manuals specified under Section 1.5.
 - 4. A list of the MANUFACTURER'S recommended spare parts, in addition to those specified in Section 2.4.
 - 5. Complete pump drive specifications and control systems data.
- B. Test Reports to be Submitted:
 - 1. A schedule of the date of shop testing and delivery of the equipment to the job site.
 - 2. Copies of all test results, as specified.
- C. Submit the MANUFACTURER'S Certificate of Installation, Testing and Instruction in accordance with Section 3.4.D "Contractor Services."
- D. In the event that it is impossible to conform to certain details of the Specifications due to different manufacturing techniques, describe completely all non-conforming aspects.

1.5 Operations and Maintenance Manuals

- A. Operating and maintenance manuals shall be furnished. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc., that are required to instruct operation and maintenance personnel unfamiliar with such equipment.

1.6 Tools and Spare Parts

- A. Spare Parts furnished in accordance with Section 2.4 "Spare Parts," shall be properly labeled for easy identification without opening the packaging and suitably protected for long term storage.
- B. Tools and spare parts shall be stored in a clearly labeled container.

1.7 Product Handling

- A. All parts shall be properly protected for indoor storage within a temperature range of 32 to 110 degrees Fahrenheit, so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.
- B. Factory assembled major components shall not be dismantled for shipment or installation unless permission is received in writing from the ENGINEER.
- C. Each box or package shall be properly marked to show its contents.

1.8 Warranty

- A. All equipment shall be warranted for workmanship by the CONTRACTOR and the equipment component MANUFACTURERS.

PART 2 - PRODUCTS

2.1 General

- A. The equipment covered by these Specifications shall be of standard units of proven ability as manufactured by reputable companies having long experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed as shown on the Drawings. This equipment is to be supplied by Engineered Control Products, 412 Beaver Creek Rd., Oregon City, OR 97045, Phone (503) 656-4880. OIT shall purchase and CONTRACTOR shall install all chlorination equipment from Engineered Control Products, as shown on the plans. All equipment shall be designed and built for 24-hour continuous service at any and all points within the specified range of operation, without overheating, without cavitation, and without excessive vibration or strain. All parts shall be so designed and proportioned as to have liberal strength, stability, and stiffness and to be especially adapted for the service to be performed. Ample room for inspection, repairs and adjustment shall be provided.
- B. Stainless steel nameplates giving the name of the MANUFACTURER, serial number and material code and all other pertinent data, shall be attached to each component.

2.2 Booster Pump for Chlorine Gas Injection

| | |
|--------------------|------------------------------------|
| Manufacturer Model | Grundfos |
| Model | CR1-4 |
| Type | Vertical, Multi Stage Booster Pump |
| Motor Power | 115/230 v Single Phase |
| Pump Speed | 3500 revolutions per minute |
| Connection Type | Oval 1" FIP Flange |

2.3 Chlorine Proportional Flow Controller

| | |
|--------------------|--------------------|
| Manufacturer Model | Wallace & Tiernan |
| Model | V10KRWA2X2 |
| Type | SFC-SC Controller |
| Motor Power | 115 v Single Phase |

2.4 Other plumbing and wiring as shown on the Drawings and in the Specifications

PART 3 - EXECUTION

3.1 Installation

- A. The equipment shall be installed in accordance with the MANUFACTURER'S instructions and recommendations in the locations shown on the drawings. Installation shall include furnishing the required oil or grease for initial operation. The grades of oil and grease shall be in accordance with the MANUFACTURER'S recommendations. Anchor bolts shall be set in accordance with the MANUFACTURER'S recommendations.

3.2 Inspection and Testing

- A. General:
1. The ENGINEER shall have the right to inspect, test or witness tests of all materials or equipment to be furnished under these specifications, prior to their shipment from the point of manufacture.
 2. The ENGINEER shall be notified two weeks prior to initial shipment, in ample time so that arrangements can be made for inspection by the ENGINEER.
 3. Field tests shall not be conducted until such time that the entire installation is complete and ready for testing.
- B. CONTRACTOR Services
1. Field Pump Tests
 - a. All pumps operating settings, alarms, controls, and shutdown devices shall be calibrated and tested during the field tests.
 - b. Deliver to the ENGINEER, upon completion of satisfactory testing of the equipment, test reports, as agreed upon with the MANUFACTURER, in accordance with the process to obtain MANUFACTURER'S certificate of installation.

END OF SECTION

DIVISION 11
SECTION 11600
METASYS SYSTEM

PART 1 - GENERAL

1.1 Description Of Work

- A. The CONTRACTOR will upgrade the existing MetaSys system to incorporate the following functions at each location:
1. Well #4
 - a. Pump Status (Current Switch)
 - b. Pump Alarm (Not currently used)
 - c. Well #4 Flow (New Flow Meter to be installed at a later date by OIT)
 2. Well #1
 - a. Pump Status (Current Switch)
 - b. Pump Alarm (VFD signal)
 - c. Well #1 Flow (Existing Flow Meter)
 - d. Controller to collect and receive data from Storage Tank, Well #1, Well #4 and Geothermal Building (New NCE Digital Controller)
 3. Storage Tank
 - a. Tank Level (New Ultrasonic Meter)
- B. In addition to the requirements of these specifications, the quality assurance shall comply with the MANUFACTURER'S instructions and recommendations for work.
- C. These Specifications are intended to give a general description of what is required, but do not cover all details, which will vary in accordance with the requirements of the desired equipment application.

1.2 References and Standards

- A. The design, fabrication, manufacturing and assembly of the equipment as specified herein shall be in conformance with the standards of the organizations listed below. Where reference is made to a standard of one of the following or other organizations, the version of the standard in effect at the time of the bid opening shall apply.
1. IEEE – Institute of Electrical and Electronics Engineers
 2. NEC – National Electrical Code
 3. NEMA – National Electrical Manufacturer's Association
 4. OSHA – Occupational Safety and Health Administration

1.3 Quality Assurance and Qualifications

- A. To guarantee unity of responsibility, the specified equipment shall be provided and coordinated by the MANUFACTURER. The CONTRACTOR shall assume full responsibility for the satisfactory operation of the equipment.

1.4 Submittals

- A. Related Documents: Copies of all materials required, establishing compliance with the Specifications, shall be submitted in accordance with the provisions of the proposed equipment. The submittal format shall be in the form of a booklet, suitably tabbed and divided to cover at least the areas noted below for each major equipment item. The submittal booklet shall include adequate detail and sufficient information for the ENGINEER to determine that all of the equipment proposed meets the detailed requirements of the Specifications. Incomplete or partial submittals will not be reviewed. Submittals shall include at least the following:
 - 1. Certified shop and drawings showing all important details of construction, and dimensions.
 - 2. Descriptive brochure and literature, bulletins and/or catalogs of the equipment.
 - 3. A complete bill of materials of all equipment. This may be furnished with Operation and Maintenance manuals specified under Section 1.5.
 - 4. A list of the MANUFACTURER'S recommended spare parts, in addition to those specified in Section 2.4.
 - 5. Complete specifications and control systems data.
- B. Test Reports to be Submitted:
 - 1. A schedule of the date of testing and delivery of the equipment to the job site.
 - 2. Copies of all test results, as specified.
- C. Submit the MANUFACTURER'S Certificate of Installation, Testing and Instruction in accordance with Section 3.4.D "Contractor Services."
- D. In the event that it is impossible to conform to certain details of the Specifications due to different manufacturing techniques, describe completely all non-conforming aspects.

1.5 Operations and Maintenance Manuals

- A. Operating and maintenance manuals shall be furnished. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc., that are required to instruct operation and maintenance personnel unfamiliar with such equipment.

1.6 Tools and Spare Parts

- A. Spare Parts furnished in accordance with Section 2.4 “Spare Parts,” shall be properly labeled for easy identification without opening the packaging and suitably protected for long term storage.
- B. Tools and spare parts shall be stored in a clearly labeled container.

1.7 Product Handling

- A. All parts shall be properly protected for indoor storage within a temperature range of 32 to 110 degrees Fahrenheit, so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.
- B. Factory assembled major components shall not be dismantled for shipment or installation unless permission is received in writing from the ENGINEER.
- C. Each box or package shall be properly marked to show its contents.

1.8 Warranty

- A. All equipment shall be warranted for workmanship by the CONTRACTOR and the equipment component MANUFACTURERS.

PART 2 - PRODUCTS

2.1 General

- A. The equipment covered by these Specifications shall be of standard units of proven ability as manufactured by reputable companies having long experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed as shown on the Drawings. As shown on Plan Sheet C-3, this equipment is intended to be supplied by Johnson Controls, Inc., 588 Parsons Dr., Suite B, Medford, OR 97501, Phone (541) 857-5112. CONTRACTOR shall use the specified supplier unless approval of alternate supplier is received in writing from the ENGINEER.

2.2 Storage Tank

- A. 344d Mercoïd Ultrasonic Level Meter or approved equal
- B. Run (6) 2 conductor, 18ga, twisted shielded cables in existing conduit
- C. Run (2) 3 conductor, 18ga, twisted shielded cables in existing conduit

2.3 Well #1

- A. CSD (Current Switch Device) reporting whether pump is on or off
- B. LS 900 Antenna or approved equal
- C. NCE Controller or approved equal
- D. Wiring to complete installation

2.4 Well #4

- A. CSD (Current Switch Device) reporting whether pump is on or off
- B. Run (6) 2 conductor, 18ga, twisted shielded cables in existing conduit
- C. Run (2) 3 conductor, 18ga, twisted shielded cables in existing conduit

EXECUTION

2.5 Installation

- A. The equipment shall be installed in accordance with the MANUFACTURER'S instructions and recommendations in the locations shown on the drawings.
- A. General:
 - 1. The ENGINEER shall have the right to inspect, test or witness tests of all materials or equipment to be furnished under these specifications, prior to their shipment from the point of manufacture.
 - 2. The ENGINEER shall be notified two weeks prior to initial shipment, in ample time so that arrangements can be made for inspection by the ENGINEER.
 - 3. Field tests shall not be conducted until such time that the entire installation is complete and ready for testing.
- B. Field Inspection and OWNER Instruction:
 - 1. The CONTRACTOR shall furnish the services of the MANUFACTURER'S field service technician, who has complete knowledge of proper operation and maintenance of the equipment, for a period of not less than two (2) days to inspect the installed equipment, supervise the initial test run, and to provide instruction to the plant personnel.

END OF SECTION

DIVISION 15

SECTION 15020

GENERAL MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 General Mechanical Systems

- A. It is the intent of the OWNER to have a complete and operable facility. All Facilities shall be tested during construction and/or during the CONTRACTOR's operational period to insure the facility is complete, is operable to the satisfaction of the ENGINEER, and meets the design performance requirements.
- B. General test requirements are specified in this section. Additional test requirements may be specified in other divisions of these Specifications and in other sections of this division. In submitting a proposal for this work, the CONTRACTOR agrees that any specified performance requirements, testing procedures, leakage allowances, or other requirements are fair and practicable and that he guarantees to secure the results specified.
- C. All costs for power, gas, water, labor and material (including chemicals) required for testing shall be borne by the CONTRACTOR.
- D. Defective items revealed by the testing shall be removed and replaced or otherwise corrected as directed by the ENGINEER and the system again subjected to the same test. All cost for power, gas, water, labor and materials (including Chemicals) required for re-testing shall be borne by the CONTRACTOR.

1.2 Equipment and Systems

- A. All equipment and systems shall be tested by the CONTRACTOR under the direction of the ENGINEER, to verify the proper operations thereof in accordance with these specifications.

1.3 Pipe and Fittings

- A. General: After completion of the installation, the CONTRACTOR shall test all piping and pipe work herein specified. The CONTRACTOR shall furnish all material, equipment, and labor for testing and re-testing the piping systems.
 - 1. Each system may be tested as a unit or in sections, but each complete system shall successfully meet the requirements specified herein before acceptance by the ENGINEER. Should any defects appear in the pipe or fittings, the necessary repairs shall be made and the line re-tested until it shall meet the requirements.
 - 2. The CONTRACTOR shall take all necessary precautions to prevent any joints from drawing while the pipelines and their appurtenances are being tested and

he shall, at his own expense, repair any damage to the pipes and their appurtenances or to any other structures resulting from or caused by these tests.

PART 2 - PRODUCTS (Not Used)

- A. Water pipe and fittings shall be Schedule 80 PVC

PART 3 - EXECUTION (Not Used)

END OF SECTION

DIVISION 16

SECTION 16000

ELECTRICAL – GENERAL PROVISIONS

PART 1 - GENERAL

1.1 Scope of Work

- A. Furnish all labor, materials, and equipment as required to install a complete and operational electrical and process instrumentation system for the project. The Scope of Work includes the areas for the Geothermal Control Center, Storage Tank, Well #1 and Well #4.
- B. The work shall include furnishing, installing and testing the equipment and materials detailed in the following specification Sections:

| <u>Section</u> | <u>Title</u> |
|----------------|--|
| 16120 | Wires and Cables – 600 Volt and Below |
| 16130 | Raceways, Boxes, Fittings and Supports |
| 16150 | Panel boards |
| 16190 | Dry-Type Transformers |
| 16450 | Grounding System |
| 16950 | Acceptance Testing and Calibration |

- C. The electrical work shall include the following:
 - 1. The installation of electrical service equipment, including the following:
 - a. Removal of existing pump motor controller for the 60hp pump, and installation of a new Variable Frequency Drive, already purchased by OIT.
 - b. Installation of a new 480v, 3 phase 200 amp service disconnect on the outside of the well building.
 - c. Installation of a new 480v, 3 phase Load Center (with service disconnects for the VFD and a 480v to 240/120v transformer) on the outside of the well building.
 - d. Installation of a new 240/120v 125 amp transformer
 - e. Installation of a new 240/120v 100 amp Load Center
 - f. Enclose well head pump wiring in conduit

1.2 Submittals

- A. Submit shop drawings for equipment, materials and other items furnished under Division 16.
- B. Shop drawings shall be submitted for the following equipment:
 - 1. Raceways, Boxes and Fittings
 - 2. Wires and Cables

3. Panel boards
 4. Grounding Hardware and Connections
- C. Check shop drawings for accuracy and contract requirements prior to submittal. Shop drawings shall be stamped with the date checked and a statement indicating that the shop drawings conform to Specifications and Drawings. This statement shall also list all exceptions to the Specifications and Drawings. Shop drawings not so checked and noted shall be returned.
- D. The ENGINEER'S check shall be for conformance with the design concept of the project and compliance with the Specifications and Drawings. Errors and omissions on approved shop drawings shall not relieve the CONTRACTOR from the responsibility of providing materials and workmanship required by the Specifications and Drawings.
- E. All dimensions shall be field verified at the job site and coordinated with the work of all other trades.
- F. Operation and Maintenance Data:
1. Submit operations and maintenance data for equipment furnished under this Division. The manuals shall be prepared specifically for this installation and shall include catalog data sheets, drawings, equipment lists, descriptions, parts lists, etc., to instruct operating and maintenance personnel unfamiliar with such equipment.
 2. Manuals shall include the following as a minimum:
 - a. A comprehensive index.
 - b. A complete "As-Built" set of approved shop drawings.
 - c. A complete list of the equipment supplied, including serial numbers, ranges and pertinent data.
 - d. Complete parts list with stock numbers, including spare parts.

1.3 Reference Standards

- A. Electric equipment, materials and installation shall comply with the latest adopted National Electrical Code (NEC) and with the latest edition of the following codes and standards:
1. National Electrical Safety Code (NESC)
 2. Occupational Safety and Health Act (OSHA)
 3. National Fire Protection Association (NFPA)
 4. National Electrical Manufacturers Association (NEMA)
 5. American National Standards Institute (ANSI)
 6. Insulated Cable Engineers Association (ICEA)
 7. Instrument Society of America (ISA)

8. Underwriters Laboratories, Inc. (UL)
 9. Factory Mutual, Inc. (FM)
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.4 Enclosure Types

- A. Unless otherwise specified herein or shown on the Drawings, electrical enclosures shall have the following ratings:
1. NEMA 4 for outdoor locations, rooms below grade (including basements and buried vaults) and "WET" locations.
 2. NEMA 4X for "CORROSIVE" locations.
 3. NEMA 7 (and listed for use in the area classifications shown) for "Class I Div. 1 Group D" and "Class I Div. 2 Group B, C and D" hazardous locations.

1.5 Service and Metering

- A. The new service disconnect is for 480 volts, 3 phase, 4 wire, 60 hertz, #300 THW copper wire service, with existing service disconnect to Well No. 1 at the OIT Geothermal Building.

1.6 Hazardous Areas

- A. Equipment, materials and installation in areas designated as hazardous on the Drawings or notes shall comply with National Electrical Code Articles 500, 501, 502 and 503.
- B. Equipment and materials installed in hazardous areas shall be UL listed for the appropriate hazardous area classification.

1.7 Codes, Inspection and Fees

- A. Equipment, materials and installation shall comply with the requirements of the local authority having jurisdiction.
- B. CONTRACTOR shall obtain all necessary permits and pay all fees required for permits and inspections.

1.8 Tests and Settings

- A. Test systems and equipment furnished under Division 16 and repair or replace all defective work. Make adjustments to the systems and instruct the OWNER'S personnel in the proper operation of the systems.
- B. Testing shall be scheduled and coordinated with the ENGINEER at least two weeks in advance. Provide qualified test personnel, instruments and test equipment.

1.9 Interpretation of Drawings

- A. Verify the exact locations and mounting heights of lighting fixtures, switches and receptacles prior to installation.
- B. Except where dimensions are shown, the locations of equipment, fixtures, outlets and similar devices shown on the Drawings are approximate only. Exact locations shall be determined by the CONTRACTOR and approved by the ENGINEER during construction. Obtain information relevant to the placing of electrical work, and in case of any interference with other work, proceed as directed by the ENGINEER and furnish all labor and materials necessary to complete the work in an approved manner.
- C. Circuit layouts are not intended to show the number of fittings, or other installation details. Furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting and other electrical systems shown in accordance with applicable codes and standards.
- D. Redesign of electrical or mechanical work, which is required due to the CONTRACTOR'S use of an alternate item, arrangement of equipment and/or layout other than specified herein, shall be done by the CONTRACTOR at his/her own expense. Redesign and detailed plans shall be submitted to the ENGINEER for approval. No additional compensation will be provided for changes in the work, either his/her own or others, caused by such redesign.

1.10 Record Drawings

- A. As the work progresses, legibly record all field changes on a set of project contract drawings, hereinafter called the "record drawings."
- B. Submit the record drawings and the schedule of control wiring raceways and wire numbers (or the point-to-point connection diagram) to the ENGINEER.

1.11 Equipment Interconnections

- A. Review shop drawings of equipment furnished under other Divisions of this Specification and prepare coordinated wiring interconnection diagrams or wiring tables. Submit copies of wiring diagrams or tables with Record Drawings.
- B. Furnish and install all equipment interconnections.

1.12 Materials and Equipment

- A. Materials and equipment shall be new, except where specifically identified on the Drawings to be reused.
- B. Material and equipment of the same type shall be the product of one MANUFACTURER and shall be UL listed.

1.13 Demolition

- A. Remove electrical work associated with equipment scheduled for demolition except those portions indicated to remain or be reused.

- B. Coordinate outages in systems with the OWNER. Where duration of proposed outage cannot be allowed by the OWNER, provide temporary connections as required to maintain service.
- C. Removal and relocation of existing conduit, wire and equipment have not been detailed on the Drawings. Survey the affected areas before submitting bid proposal.
- D. Trace out existing wiring that is to be relocated, or removed, and perform the relocation or removal work as required for a complete operating and safe system.
- E. Remove exposed conduits, wireways, outlet boxes, pull boxes and hangers made obsolete by the alterations, unless specifically designated to remain.

1.14 Disposition of Removed Materials and Equipment

- A. In general, it is intended that material and equipment indicated to be removed and disposed of by the CONTRACTOR shall, upon removal, become the CONTRACTOR'S property and shall be disposed of off the site by the CONTRACTOR, unless otherwise directed by the OWNER. A receipt showing acceptable disposal of any legally regulated materials or equipment shall be given to the OWNER.

PART 2 - EXECUTION

2.1 Installation

- A. Any work not installed according to the Drawings and Specifications shall be subject to change as directed by the ENGINEER. No extra compensation will be allowed for making these changes.
- B. Electrical equipment shall be protected at all times against mechanical injury or damage by water. Electrical equipment shall not be stored outdoors. Electrical equipment shall be stored in dry permanent shelters. Do not install electrical equipment in its permanent location until structures are weather-tight. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and tested as directed by the ENGINEER, or shall be replaced at no additional cost to OWNER at the ENGINEER'S discretion.
- C. Equipment that has been damaged shall be replaced or repaired by the equipment MANUFACTURER, at the ENGINEER'S discretion at no additional cost to OWNER.
- D. Repaint any damage to factory applied paint finish using touch-up paint furnished by the equipment MANUFACTURER. The entire damaged panel or section shall be repainted per the field painting specifications, at no additional cost to the OWNER.

END OF SECTION

DIVISION 16

SECTION 16120

WIRE AND CABLE - 600 VOLT AND BELOW

PART 1 - GENERAL

1.1 Summary

- A. Section Includes:
 - 1. Material and installation requirements for:
 - a. Building wire.
 - b. Power and control cable.
 - c. Shielded VFD cable.
 - d. Instrumentation cable.
 - e. Wire connectors.
 - f. Insulating tape.
 - g. Pulling lubricant.
- B. Related Sections include but are not necessarily limited to:
 - 1. Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. General Requirements of the Bid Package.
 - 3. Section 16000 - Electrical: Basic Requirements.

1.2 Quality Assurance

- A. Referenced Standards:
 - 1. Insulated Cable Engineers Association:
 - a. ICEA S-58-679, Control Cable Conductor Identification.
 - 2. Institute of Electrical and Electronic Engineers (IEEE):
 - a. IEEE-518, Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers from External Sources.
 - 3. National Electrical Manufacturers Association (NEMA):
 - a. ICS 4, Terminal Blocks for Industrial Use.
 - 4. National Electrical Manufacturers Association/Insulated Cable Engineers Association (NEMA/ICEA):
 - a. WC 70/ICEA S-95-658, Standard for Nonshielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.
 - 5. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - 6. Underwriters Laboratories, Inc. (UL):
 - a. 13, Power-Limited Circuit Cables

- b. 44, Thermoset-Insulated Wires and Cables.
 - c. 83, Thermoplastic-Insulated Wires and Cables.
 - d. 467, Grounding and Bonding Equipment.
 - e. 486A, Wire Connectors and Soldering Lugs for use with Copper Conductors.
 - f. 486C, Splicing Wire Connectors.
 - g. 510, Insulating Tape.
 - h. 1277, Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
 - i. 1581, Reference Standard for Electrical Wires, Cables, and Flexible Cords.
 - j. 2250, Instrument Tray Cable.
 - k. Definitions
- B. Cable: Multi-conductor, insulated, with outer sheath containing either building wire or instrumentation wire.
- C. Instrumentation Cable: Multi-conductor, insulated, twisted or untwisted, with outer sheath. The following are specific types of instrumentation cables:
- 1. Analog signal cable: Used for the transmission of low current (e.g., 4-20 mA DC) or low voltage (e.g., 0-10 V DC) signals, using No. 16 AWG and smaller conductors. Commonly used types are defined in the following:
 - a. UTP: Unshielded twisted pair (For Current Signals only)
 - b. TSP: Twisted shielded pair.
 - c. TST: Twisted shielded triad.
 - 2. Digital signal cable: Used for the transmission of digital signals between computers, PLCs, RTUs, etc.
 - 3. Power Cable: Multi-conductor, insulated, with outer sheath containing building wire, #8 AWG and larger.
 - 4. Shielded VFD Cable: Multi-conductor, insulated, with shield, drain wire and building wires, #12 and larger.
 - 5. Control Cable: Multi-conductor, insulated, with outer sheath containing building wires, #16, #14, #12 or #10 AWG.
 - 6. Building Wire: Single conductor, insulated, with or without outer jacket depending upon type.

1.3 Delivery, Storage, And Handling

- A. Per MANUFACTURER standards and per the general section of the Bid Package.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

- A. Subject to compliance with the Contract Documents, the following MANUFACTURERS are acceptable:

1. Building wire, power and control cable:
 - a. American Insulated Wire Corporation.
 - b. General Cable.
 - c. Rome Cable Corporation.
 - d. Manhattan/CDT.
 - e. Southwire Company.
2. Shielded VFD cable:
 - a. Belden Wire and Cable Company.
 - b. Olfex Wire and Cable, Inc.
3. Instrumentation cable:
 - a. Analog cable:
 - i. Alpha Wire Corporation.
 - ii. American Insulated Wire Corporation.
 - iii. Belden Wire and Cable.
 - iv. General Cable.
 - v. Manhattan/CDT.
4. Wire connectors:
 - a. Burndy Corporation.
 - b. Buchanan.
 - c. Ideal.
 - d. IlSCO.
 - e. Minnesota Mining and Manufacturing Co. (3M)
 - f. Teledyne Penn Union.
 - g. Thomas and Betts.
 - h. Phoenix Contact.
5. Insulating tape:
 - a. Minnesota Mining and Manufacturing Co. (3M)
 - b. Plymouth Bishop Tapes.
 - c. Red Seal Electric Co.

B. Submit requests for substitution to ENGINEER

2.2 Manufactured Units

A. Building Wire:

1. Conductor shall be copper with 600 V rated insulation.
2. Conductor sizes 14 AWG, 12 AWG and 10 AWG used for device wiring shall be solid. All other building wire shall be stranded.
3. Surface mark with MANUFACTURER'S name or trademark, conductor size, insulation type and UL label.
4. When direct buried, UL Listed and marked as suitable for direct burial.
5. When exposed to sunlight, UL Listed and marked as sunlight resistant.

6. Conform to NEMA/ICEA WC 70/S-95-658 and UL 83 for type THHN/THWN and THHN/THWN-2 insulation.
 7. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 for type XHHW-2 insulation.
- B. Power and Control Cable:
1. Conductor shall be copper with 600 V rated insulation.
 2. Surface mark with MANUFACTURER'S name or trademark, conductor size, insulation type and UL label.
 3. Conform to NEMA/ICEA WC 70/S-95-658 and UL 83 and 1277 for type THHN/THWN insulation with an overall PVC jacket.
 4. Number of conductors as required, including a ground conductor as follows:
 - a. Power Cable: Provided per reference standards.
 - b. Control Cable: Provided with or without bare ground conductor of the same AWG size. When a bare ground conductor is not provided an additional insulated conductor shall be provided and used as the ground conductor (e.g., 6/c #14 w/g and 7/c #14 are equal). Size shall be per reference standards.
 5. Individual conductor color coding:
 - a. Power Cable: ICEA Method 4.
 - b. Control Cable: ICEA Method 1, Table K-2.
 - c. See Part 3 of this specification for additional requirements.
 - d. When direct buried, UL Listed and marked as suitable for direct burial.
 - e. When exposed to sunlight, UL Listed and marked as sunlight resistant.
 6. If cable is in tray, conform to NFPA 70 Type TC.
 7. Shielded VFD Cable:
 - a. Conductor shall be copper, stranded with 600 V rated insulation.
 - b. Surface mark with MANUFACTURER'S name or trademark, conductor size, insulation type and UL label.
 - c. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 and 1277 for type RHW-2 or XHHW-2 insulation with an overall PVC jacket.
 - d. Shielding: 85 percent tinned copper braid, full size tinned copper drain wire and 100 percent foil shield.
 - e. Number of conductors: 3 PH and minimum 1 full size ground.
 - f. Individual conductor color coding:
 - i. ICEA Method 4.
 - ii. See Part 3 of this specification for additional requirements.

- C. Instrumentation Cable:
 - 1. Surface mark with MANUFACTURER'S name or trademark, conductor size, insulation type and UL label.
 - 2. Analog cable:
 - a. Tinned copper conductors.
 - b. 300 V or 600 V PVC insulation with PVC jacket.
 - c. Twisted or twisted with 100 percent foil shield coverage with drain wire.
 - d. When direct buried, UL Listed and marked as suitable for direct burial.
 - e. When exposed to sunlight, UL Listed and marked as sunlight resistant.
 - f. Individual conductor color coding: ICEA Method 1, Table K-2.
 - g. Conform to UL 2250, UL 1581 and NFPA 70 Type ITC.
 - 3. Digital cable:
 - a. As recommended by equipment (e.g., PLC, RTU) MANUFACTURER.
- D. Wire Connectors:
 - 1. Twist/Screw on type:
 - a. Insulated pressure or spring type solderless connector.
 - b. 600 V rated.
 - c. Ground Conductors: Conform to UL 468C and/or UL 467 when required by local codes.
 - d. Phase and neutral conductors: Conform to UL 486C.
 - 2. Compression and mechanical screw type:
 - a. 600 V rated.
 - b. Ground conductors: Conform to UL 467.
 - c. Phase and neutral conductors: Conform to UL 486A.
 - 3. Terminal block type:
 - a. High density, screw-post barrier-type with white center marker strip
 - b. 600 V and ampere rating as required, for power circuits.
 - c. 600 V, 20 ampere rated for control circuits.
 - d. 300 V, 15 ampere rated for instrumentation circuits.
 - e. Conform to NEMA ICS 4 and UL 486A.
- E. Insulating Tape:
 - 1. Pressure sensitive vinyl.
 - 2. Premium grade.
 - 3. Heat, cold, moisture, and sunlight resistant.
 - 4. Thickness, depending on use conditions: 7, 8.5, or 10 mil.
 - 5. For cold weather or outdoor location, tape must also be all-weather.
 - 6. Comply with UL 510.
- F. Pulling Lubricant: Cable MANUFACTURER'S standard containing no petroleum or other products which will deteriorate insulation.

PART 3 - EXECUTION

3.1 Installation

- A. Permitted Usage of Insulation Types (Conduit sizes in schedule are based on THWN):
1. Type XHHW-2:
 - a. Building wire, power, and control cable in architectural and non-architectural finished areas.
 - b. Building wire and power and control cable in conduit below grade.
 2. Type THHN/THWN and THHN/THWN-2:
 - a. Building wire, power, and control cable in architectural and non-architectural finished areas.
 - b. Building wire, power, and control cable in conduit below grade.
 3. Type RHW-2:
 - a. Building wire, power, and control cable in architectural and non-architectural finished areas.
 - b. Building wire, power, and control cable in conduit below grade.
- B. Usage of Shielded VFD Cable:
1. All VFD branch circuits 50 horsepower and smaller.
- C. Conductor Size Limitations:
1. Feeder and branch power conductors shall not be smaller than No. 12 AWG unless otherwise indicated on the Drawings.
 2. Control conductors shall not be smaller than No. 14 AWG unless otherwise indicated on the Drawings.
 3. Instrumentation conductors shall not be smaller than No. 16 AWG unless otherwise indicated on the Drawings.
- D. Color Code All Wiring as Follows:
1. Building wire:

| 240V, 208V, 240/120 V, 208/120 V | 480 V, 480/277 V | |
|----------------------------------|------------------|---------------|
| Phase 1 | Black | Brown |
| Phase 2 | Red | Orange |
| Phase 3 | Blue | Yellow |
| Neutral | White | White or Gray |
| Ground | Green/Bare | Green/Bare |

END OF SECTION

DIVISION 16

SECTION 16130

RACEWAYS, BOXES, FITTINGS AND SUPPORTS

PART 1 - GENERAL

1.1 Summary

- A. Section Includes
 - 1. Material and installation requirements for:
 - a. Conduits
 - b. Conduit fittings
 - c. Conduit supports
 - d. Wireways
- B. Related Sections include but are not necessarily limited to:
 - 1. Bidding Requirements, Contract Forms, and Conditions of the Contract
 - 2. General Requirements of the Bid Package
 - 3. Section 16000 – Electrical: Basic Requirements
 - 4. Section 16450 – Grounding

1.2 Quality Assurance

- A. Referenced Standards
 - 1. Aluminum Association Inc. (AA)
 - a. 1, Aluminum Standards and Data
 - 2. American Iron and Steel Institute (AISI).
 - 3. American National Standards Institute (ANSI)
 - a. C80.1, Rigid Steel Conduit - Zinc-Coated
 - b. C80.3, Electrical Metallic Tubing - Zinc-Coated
 - c. C80.5, Aluminum Rigid Conduit - (ARC)
 - d. C80.6, Intermediate Metal Conduit - Zinc-Coated
 - 4. ASTM International (ASTM)
 - a. A123, Standard Specification for Zinc Coating (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - b. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - c. D1784, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

- d. D2564, Solvent Cements for (PVC) Plastic Pipe, Tubing, and Fittings
 - e. E84, Standard Test Method for Surface Burning Characteristics of Building Materials
 - f. F512, Standard Specification for Smooth-Wall Poly (Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation
5. National Electrical Manufacturers Association (NEMA)
- a. OS 1, Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
 - b. RN 1, Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
 - c. TC 2, Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)
 - d. TC 3, PVC Fittings for Use with Rigid PVC Conduit and Tubing
 - e. TC 6, PVC Plastic Utilities Duct for Underground Installations
 - f. 250, Enclosures for Electrical Equipment (1000 Volts Maximum)

1.3 Submittals

- A. Shop Drawings
 - 1. Section 16000

1.4 Delivery, Storage, and Handling

- A. Product Delivery, Storage, and Handling per MANUFACTURER recommendations and per Bid Package requirements.

PART 2 - PRODUCTS

2.1 Flexible Conduit

- A. Flexible Galvanized Steel Conduit (FMC)
 - 1. Formed of continuous, spiral wound, hot-dip galvanized steel strip with successive convolutions securely interlocked.
 - 2. Standard: UL 1.
- B. PVC-Coated Flexible Galvanized Steel (liquid-tight) Conduit (LFMC)
 - 1. Core formed of continuous, spiral wound, hot-dip galvanized steel strip with successive convolutions securely interlocked.
 - 2. Extruded PVC outer jacket positively locked to the steel core.
 - 3. Liquid and vaportight.
 - 4. Standard: UL 360.

PART 3 - EXECUTION

3.1 Raceway Installation - General

- A. Shall be in accordance with the requirements of NFPA 70.
- B. Size of Raceways
 - 1. Raceway sizes are shown on the Drawings, if not shown on the Drawings, then size in accordance with NFPA 70.
 - 2. Unless specifically indicated otherwise, the minimum raceway size shall be:
 - a. Conduit: 3/4 IN.
 - b. Wireway: 2-1/2 IN x 2-1/2 IN.
- C. Field Bending and Cutting of Conduits
 - 1. Utilize tools and equipment recommended by the MANUFACTURER of the conduit, designed for the purpose and the conduit material to make all field bends and cuts.
 - 2. Do not reduce the internal diameter of the conduit when making conduit bends.
 - 3. Prepare tools and equipment to prevent damage to the PVC coating.
 - 4. Degrease threads after threading and apply a zinc rich paint.
 - 5. Debur interior and exterior after cutting.
- D. Male threads of conduit systems shall be coated with an electrically conductive anti-seize compound.
- E. The protective coating integrity of conduits, fittings, and accessories shall be maintained.
 - 1. Repair STEEL RMC and EMT utilizing a zinc rich paint.
 - 2. Repair PVC-STEEL RMC utilizing a patching compound, of the same material as the coating, provided by the MANUFACTURER of the conduit; or a self-adhesive, highly conformable, cross-linked silicone composition strip, followed by a protective coating of vinyl tape. The total nominal thickness: 40 mil.
 - 3. Repair surfaces which will be inaccessible after installation prior to installation.
- F. Remove moisture and debris from conduit before wire is pulled into place.
 - 1. Pull mandrel with diameter nominally 1/4 IN smaller than the interior of the conduit, to remove obstructions.
 - 2. Swab conduit by pulling a clean, tight-fitting rag through the conduit.
 - 3. Tightly plug ends of conduit with tapered wood plugs or plastic inserts until wire is pulled.
- G. Only nylon or polyethylene rope shall be used to pull wire and cable in conduit systems.

- H. Where portions of a raceway are subject to different temperatures and where condensation is known to be a problem, as in cold storage areas of buildings or where passing from the interior to the exterior of a building, the raceway shall be sealed to prevent circulation of warm air to colder section of the raceway.
- I. Fill openings in walls, floors, and ceilings and finish flush to match surrounding surface in texture and color.

3.2 Raceway Routing

- A. Raceways shall be routed in the field unless otherwise indicated.
 - 1. Conduit and fittings shall be installed, as required, for a complete system that has a neat appearance and is in compliance with all applicable codes.
 - 2. Run in straight lines parallel to or at right angles to building lines.
 - 3. Do not route conduits:
 - a. Through areas of high ambient temperature or radiant heat.
 - b. In suspended concrete slabs.
 - 4. Conduit shall not interfere with, or prevent access to, piping, valves, ductwork, or other equipment for operation, maintenance and repair.
 - 5. Provide pull boxes or conduit bodies as needed so that there is a maximum of 360 degrees of bends in the conduit run or in long straight runs to limit pulling tensions.
- B. All rigid conduits within a structure shall be installed exposed except as follows:
 - 1. As indicated on the Drawings.
 - 2. Concealed above gypsum wall board or acoustical tile suspended ceilings.
 - 3. Concealed within stud frame, poured concrete, concrete block and brick walls of an architecturally finished area.
 - 4. Embedded in floor slabs or buried under floor serving equipment in non-architecturally finished areas that are not located on or near a wall or column and the ceiling height is greater than 12 FT.
 - 5. Embedded in floor slabs or buried under floor slabs where shown on the Contract Drawings or with the ENGINEER'S permission.
- C. Maintain minimum spacing between parallel conduit and piping runs in accordance with the following when the runs are greater than 30 FT:
 - 1. Between instrumentation and telecommunication: 1 IN.
 - 2. Between instrumentation and 125 V, 48 V and 24 V DC, 2 IN.
 - 3. Between instrumentation and 600 V and less AC power or control: 6 IN.
 - 4. Between instrumentation and greater than 600 V AC power: 12 IN.
 - 5. Between telecommunication and 125 V, 48 V and 24 V DC, 2 IN.

6. Between telecommunication and 600 V and less AC power or control: 6 IN.
 7. Between telecommunication and greater than 600 V AC power: 12 IN.
 8. Between 125 V, 48 V and 24 V DC and 600 V and less AC power or control: 2 IN.
 9. Between 125 V, 48 V and 24 V DC and greater than 600 V AC power: 2 IN.
 10. Between 600 V and less AC and greater than 600 V AC: 2 IN.
 11. Between process, gas, air and water pipes: 6 IN.
- D. Conduits shall be installed to eliminate moisture pockets. Where water cannot drain to openings, provide drain fittings in the low spots of the conduit run.
 - E. Conduit shall not be routed on the exterior of structures except as specifically indicated on the Drawings.
 - F. Where sufficient room exists within the housing of roof-mounted equipment, the conduit shall be stubbed up inside the housing.
 - G. Provide all required openings in walls, floors, and ceilings for conduit penetration.

3.3 Raceway Applications

- A. Permitted raceway types per wire or cable types:
 1. Power wire or cables: All raceway types.
 2. Control wire or cables: All raceway types.
 3. Instrumentation cables: Metallic raceway except non-metallic may be used underground.
 4. Motor leads from a VFD: Metallic conduits except EMT.
 5. Telecommunication cables: All raceway types.
 6. Classified areas per NEC (NFPA 70) with seal offs at boundary changes.
- B. Permitted raceway types per area designations:
 1. Dry areas
 - a. STEEL RMC
 2. Wet areas
 - a. STEEL RMC
 - b. PVC-STEEL RMC
 3. Corrosive areas
 - a. PVC-STEEL RMC
- C. Permitted raceway types per routing locations
 1. In stud framed walls
 - a. EMT
 - b. STEEL RMC

2. In concrete block or brick walls
 - a. PVC-40
 - b. PVC-80
 - c. STEEL RMC
3. Through floor penetrations
 - a. STEEL RMC wrapped with factory applied weather and corrosion protection tape when emerging from concrete into areas designated as dry, wet, corrosive or highly corrosive.
 - b. PVC-STEEL RMC in areas designated as wet, corrosive or highly corrosive.
- D. LFMC and FLEX-NM conduits shall be install as the final conduit connection to light fixtures, dry type transformers, motors, electrically operated valves, instrumentation primary elements, and other electrical equipment that is liable to vibrate. The maximum length shall not exceed:
 1. 6 FT to light fixtures
 2. 3 FT to motors
 3. 2 FT to all other equipment
- E. HAZ-FLEX coupling shall be installed as the final conduit to motors, electrically operated valves, instrumentation primary elements and electrical equipment that is liable to vibrate. The maximum length shall not exceed:
 1. 3 FT to motors
 2. 2 FT to all other equipment
- F. NEMA 1 Rated Wireway
 1. Surface mounted in electrical rooms
- G. NEMA 3R Wiring Trough
 1. Surface mounted in exterior locations
- H. NEMA 4X Rated Wireway
 1. Surface mounted in areas designated as wet and or corrosive.
- I. NEMA 12 Rated Wireway
 1. Surface mounted in areas designated as dry in architecturally and non-architecturally finished areas.
- J. Underground conduit: See Section 16600.

3.4 Conduit Fittings and Accessories

- A. Conduit Seals
 1. Installed in conduit systems located in hazardous areas as required by the NFPA 70.
- B. Rigid non-metallic conduit and fittings shall be joined utilizing solvent cement.

1. Immediately after installation of conduit and fitting, the fitting or conduit shall be rotated 1/4 turn to provide uniform contact.
- C. Install Expansion Fittings
1. Where conduits span structural expansions joints.
 2. Where conduits are exposed to the sun and conduit run is greater than 200 FT.
 3. Elsewhere as identified on the Drawings.
- D. Install Expansion/Deflection Fittings
1. Where conduits enter a structure.
 - a. Except electrical manholes and handholes.
 - b. Except where the ductbank is tied to the structure with rebar.
 2. Elsewhere as identified on the Drawings.
- E. Threaded connections shall be made wrench-tight.
- F. Conduit Joints shall be watertight:
1. Where subjected to possible submersion.
 2. In areas classified as wet.
 3. Underground.
- G. Terminate Conduits
1. In outlet boxes
 - a. With an insulated grounding bushing and locknut.
 - b. With an insulated compression type connector.
 2. In NEMA 1 rated enclosures
 - a. With an insulated grounding bushing and locknut.
 3. In NEMA 12 rated enclosures
 - a. With an insulated grounding bushing a gasketed locknut.
 4. In NEMA 4 and 4X rated enclosures
 - a. With a threaded, insulated and gasketed hub.
 5. In NEMA 7 and 9 rated enclosures
 - a. Into a factory installed drilled and taped hole (Division 1).
 - b. Into an integral threaded hub (Division 2).
 6. When stubbed up through the floor into floor mount equipment
 - a. With an insulated grounding bushing.
- H. Threadless couplings shall only be used to join new Galvanized RMC to existing Galvanized RMC conduit or new IMC to existing IMC conduit when the existing conduit end is not threaded and it is not practical or possible to cut threads on the existing conduit with a pipe threader.

3.5 Conduit Support

- A. Permitted multi-conduit surface or trapeze type support system per area designations and conduit types.
 - 1. Dry or wet and/or hazardous areas
 - a. Galvanized system consisting of galvanized steel channels and fittings, nuts and hardware and conduit clamps.
 - 2. Conduit type shall be compatible with the support system material
 - a. Galvanized steel system may be used with STEEL RMC and STEEL IMC and EMT.
 - b. Stainless steel system may be used with STEEL STEEL RMC and STEEL IMC and PVC-STEEL STEEL RMC.
 - c. PVC coated galvanized steel system may be used with PVC-STEEL STEEL RMC and PVC-40 and PVC-80.
 - d. Fiberglass system may be used with PVC-40 and PVC-80 and PVC-STEEL RMC.
- B. Conduit support general requirements
 - 1. Maximum spacing between conduit supports per NFPA 70.
 - 2. Support conduit from the building structure.
 - 3. Do not support conduit from process, gas, air or water piping; or from other conduits.
 - 4. Provide hangers and brackets to limit the maximum uniform load on a single support to 25 LBS or to the maximum uniform load recommended by the MANUFACTURER if the support is rated less than 25 LBS.
 - a. Do not exceed maximum concentrated load recommended by the MANUFACTURER on any support.
 - b. Conduit hangers: Continuous threaded rods combined with struts or conduit clamps: Do not use perforated strap hangers and iron bailing wire.
 - c. Do not use suspended ceiling support systems to support raceways.
 - d. Hangers in metal roof decks:
 - i. Utilize fender washers.
 - ii. Not extend above top of ribs.
 - iii. Not interfere with vapor barrier, insulation, or roofing.
 - 5. Conduit support system fasteners
 - a. Use sleeve-type expansion anchors as fasteners in masonry wall construction. Do not use concrete nails and powder-driven fasteners.

END OF SECTION

DIVISION 16
SECTION 16150
PANELBOARDS

PART 1 - GENERAL

1.1 Summary

- A. Section Includes
 - 1. Distribution panel boards
- B. Related Sections include but are not necessarily limited to:
 - 1. Bidding Requirements, Contract Forms, and Conditions of the Contract
 - 2. Section 16000 - Electrical: Basic Requirements
 - 3. Section 16450 - Grounding

1.2 Quality Assurance

- A. Referenced Sections
 - 1. National Electrical Manufacturers Association (NEMA)
 - a. PB 1, Panelboards
 - 2. National Fire Protection Association (NFPA)
 - a. National Electric Code (NEC)
 - 3. Underwriters Laboratories, Inc (UL)
 - a. 67, Panelboards
 - b. 50, Cabinets and Boxes
 - c. 489, Molded Case Circuit Breakers
 - d. 943, GFCI
 - e. 1449, Standard for Safety, Transient Voltage Surge Suppressors

1.3 Submittals

- A. Shop Drawings
 - 1. Panel layout with alphanumeric designation, branch circuit breaker sizes and types, as indicated in the panel schedules.

1.4 Delivery, Storage, and Handling

- A. Product Delivery, Storage, and Handling per MANUFACTURER standards and Bid Requirements.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Panelboards and circuit breakers
 - a. General Electric
 - b. Siemens
 - c. Square D
 - d. Eaton/Cutler Hammer
 - e. Or equal

2.2 Manufactured Units

- A. Panelboards
1. UL 67 listed.
 2. Designed in accordance with NEC Article 384.
 3. Dead-front type.
 4. Fronts
 - a. Steel reinforced.
 - b. Concealed or semi-concealed hinges.
 - c. Trim adjusting screws.
 - d. Directory card mounted inside front door.
 - e. Corrosion proof lock with retractable latch.
 - f. Surface or flush mounting as required.
 - g. Doors and exterior panels to be minimum 14 gauge.
 5. Bus bars
 - a. Sequenced phased.
 - b. Tin plated copper.
 - c. Drilled and tapped on circuit pole centers.
 6. Main Breaker
 - a. Thermo-Magnetic
 - b. Symmetrical Instantaneous Short Circuit rating a minimum of 50% greater than calculated Symmetrical Fault Current
 7. Main lugs
 - a. Solderless type.
 - b. Approved for copper and aluminum UL listed wire.
 8. Solid neutral bar full rating with solderless mechanical type connectors.

9. Non-insulated grounding strip including:
 - a. Main ground lug.
 - b. Individual grounding terminals for each circuit breaker and circuit breaker space.
 10. Maximum panel voltage
 - a. 240 V AC for lighting panelboards.
 - b. 600 V AC for distribution panelboards.
 11. See Drawings for additional requirements.
- B. Panel Boxes and Cabinets
1. UL 50 listed.
 2. Gutter space per NEC and UL requirements.
 3. Code gage galvanized steel.
 4. Provide panels without knock-outs.
 5. Nominal 5-3/4 IN deep.
 6. Doors and exterior panels to be minimum 14 gauge.
 7. NEMA 4 rated unless otherwise indicated on the drawings.
- C. Circuit Breakers
1. Current rating as indicated on the Drawings.
 2. Thermal-magnetic type, UL listed.
 - a. Over-center, toggle handle operated.
 - b. Quick-make, quick-break action.
 - i. Independent of toggle handle operation.
 - c. Common tripping of all poles. Handle ties shall not be used.
 - d. Molded-in ON and OFF markings on breaker cover.
 - e. Bolt-on type.
 - f. Three-position handles indicating ON, OFF and TRIPPED.
 - g. Removable from front of panelboard without disturbing adjacent circuit breakers.
 - h. One-, two- or three-pole as indicated on the Drawings.
 - i. Rated 10,000 AIC, minimum, unless a higher interrupting rating is noted on the Drawings.
 - j. Tandem or half-size circuit breakers shall not be used.
 3. GFCI type, UL listed.
 - a. Characteristics as indicated for the thermal-magnetic type above:
 - i. Except one- or two-pole as indicated on the Drawings.
 - ii. Plus the following features:

- b. Class A ground fault circuit.
 - c. Trip on 5 mA ground fault (4-6 mA range).
- D. Electric Service Disconnect Panel, including Main Building service disconnect, and circuit disconnects for 1) New VFD pump controller and 2) 480V to 240/120V transformer, shall be Eaton/Cutler Hammer as described in the device description at the end of this section, or approved equal.

2.3 Transient Voltage Surge Suppression

- A. Service entrance rated panelboards shall be provided with a transient voltage surge suppression system for the protection of all AC electrical circuits from the effects of lightning-induced currents, substation switching transients, and internally generated transients resulting from inductive and/or capacitive load switching.
- B. Suppressors shall be listed in accordance with UL 1449, Standard for Safety, Transient Voltage Surge Suppressors.
- C. Suppressors shall be mounted internal to and integral with the panelboard.
- D. Suppressors shall be provided with dry contacts output to monitor alarm status.
- E. Suppressor shall be provided with surge counter which displays the combined total number of transient voltage surges detected.
- F. Visible indication of proper suppressor connection and operation shall be provided and shall be visible without removal of the panel deadfront.
- G. The mounting position of the suppressor shall permit a straight and short lead length connection between the suppressor and the point of connection to the main bus.
- H. Suppressors shall meet or exceed the following criteria:
 - 1. Peak Surge Current Rating Per Phase (based on 8/20us Waveform): 120,000 Amps.
 - 2. Maximum Clamping Voltage Rating (Tested to ANSI/IEEE C62.41-1980 Cat. B, 6000V, 1.2/50us, 3000A 8/20 us Waveforms): 600 Volt.
 - 3. Transient Joule Rating/Phase (Based on 10/1000 μ s Waveforms): 920 Joules.
- I. Units may be manufactured using Metal Oxide Varistors (MOV's) as primary suppression component, or as a "hybrid" system using MOVs, Gas Tubes, Inductors, capacitors, and/or diodes. However, units relying solely on gas tubes or diodes are not acceptable.
- J. Suppressors shall be of solid-state componentry and shall operate bi-directionally.
- K. Suppressors shall be of Square D IMA or IBA series, or approved equal.

PART 3 - EXECUTION

3.1 Installation

- A. Install per manufacturer's instructions.

- B. Install in accordance with the NEC.
- C. Provide each panelboard with a typed "as installed" directory.

| | | General Information | | (Section 1 of 1) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---------------------|--|-------------|--|---------------------|------------|--|---|--|--|--|-----|-------|------|-------|------|------|---|---|-----|-----|-----|----|---|---|----|-----|-----|----|----|---|--|------|--|--|
| | | Service Voltage: 480Y/277V 3Ph 4W Bus Rating & Type: 225A Copper Ground Bar: Std. Bolted Aluminum, Al or Cu cable S.C. Rating: 14k A.I.C. Fully Rated | | Enclosure: Type 3R Neutral Rating: 225A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Main Device Type: Main Breaker - Bottom Cable Entry Main Terminals: Mechanical - (1) #14-4/0 (Cu/Al) Neutral Terminals: Mechanical - (1) #6-300 kcmil (Cu/Al) Box Catalog No.: LWPQ2036 Trim: Complete Enclosure (Includes Trim) | | Surface Mounted | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Box Dimensions: 36." [914.4mm]H x 20" [508.0mm]W x 6.5" [165.1mm]D Min. Gutter Size: Top = 5.5" [139.7mm] Bottom = 5.5" [139.7mm] Left = 5.75" [146.0mm] Right = 5.75" [146.0mm] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Panel ID Nameplate: (1) MDP Type: Plastic, adhesive-backed (2) 480Y/277V 3Ph 4W Color: White with Black Letters (3) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | UL | | ***Non-Interchangeable Main Device*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Copper Neutral Trim Lock:T-Handle Lock Assembly Circuit Directory:Plastic Sleeve with Card Painted Box:ANSI 61 Main Circuit Breaker Trip Type: Thermal-Magnetic. Seismic Label (IBC/CBC Seismic Qualified). Do not connect breakers with combined ampere ratings that exceed 140 amperes on any individual branch bus connector. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Device Modifications: <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Ref #</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>1223C77G03</td> <td>Padlockable Lockoff</td> </tr> <tr> <td>Ckt # 1, 7</td> <td></td> </tr> </tbody> </table> | | Ref # | Description | 1223C77G03 | Padlockable Lockoff | Ckt # 1, 7 | | Branch Devices <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Qty</th> <th>Poles</th> <th>Trip</th> <th>Frame</th> <th>Amps</th> <th>KAIC</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>3</td> <td>100</td> <td>GHB</td> <td>100</td> <td>14</td> </tr> <tr> <td>1</td> <td>2</td> <td>70</td> <td>GHB</td> <td>100</td> <td>14</td> </tr> <tr> <td>13</td> <td>1</td> <td></td> <td>PROV</td> <td></td> <td></td> </tr> </tbody> </table> | | | | Qty | Poles | Trip | Frame | Amps | KAIC | 1 | 3 | 100 | GHB | 100 | 14 | 1 | 2 | 70 | GHB | 100 | 14 | 13 | 1 | | PROV | | |
| Ref # | Description | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1223C77G03 | Padlockable Lockoff | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Ckt # 1, 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Qty | Poles | Trip | Frame | Amps | KAIC | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 3 | 100 | GHB | 100 | 14 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 2 | 70 | GHB | 100 | 14 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 13 | 1 | | PROV | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Notes: | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| The information on this document is created by Eaton Corporation. It is disclosed in confidence and it is only to be used for the purpose in which it is supplied. | | PREPARED BY D091 | | DATE 04/10/13 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | APPROVED BY | | JOB NAME OIT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | VERSION 7.9 | | DESIGNATION MDP | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | TYPE PRL2a | | DRAWING TYPE Customer Approval | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| NEG ALT NUMBER D09104101301-0000 | | REVISION A | | DWG SIZE G.O. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | G.O. | | ITEM 1 OF 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

END OF SECTION

DIVISION 16
SECTION 16190
TRANSFORMERS

PART 1 - GENERAL

1.1 Summary

- A. Section Includes
 - a. 480v to 240/120v transformer.
- B. Related Sections include but are not necessarily limited to
 - 1. Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Section 16000 - Electrical: Basic Requirements.
 - 3. Section 16450 - Grounding.

1.2 Quality Assurance

- A. Referenced Standards
 - 1. American National Standards Institute (ANSI)
 - a. C89.2, Dry-Type Transformers for General Applications.
 - 2. National Electrical Manufacturers Association (NEMA)
 - a. ST 20, Dry-Type Transformers for General Applications.
 - 3. Underwriters Laboratories Inc. (UL)
 - a. 506, Specialty Transformers.

1.3 Submittals

- A. Shop Drawings
 - 1. UL nameplate data.

1.4 Delivery, Storage, and Handling

- A. Product Delivery, Storage, and Handling per MANUFACTURER standards and Bid Requirements.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable
 - 1. Dry-type transformers
 - a. General Electric
 - b. Square D
 - c. Cutler-Hammer
 - d. Siemens
 - e. Hammond
 - f. Or approved equal

PART 3 - EXECUTION

3.1 Installation

- A. Install products in accordance with MANUFACTURER'S instructions.
- B. Ground in accordance with Section 16450.

END OF SECTION

DIVISION 16
SECTION 16450
GROUNDING

PART 1 - GENERAL

1.1 Summary

- A. Section Includes:
 - 1. Grounding.
- B. Related Sections include but are not necessarily limited to:
 - 1. Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Section 16000 - Electrical: Basic Requirements.
 - 3. Section 16120 - Wire and Cable - 600 Volt and Below.
 - 4. Section 16130 –Raceways, Boxes, Fittings and Supports.
 - 5. Section 16950 – Acceptance Testing and Calibration.

1.2 Quality Assurance

- A. Assure ground continuity is continuous throughout the entire Project.
- B. Referenced Standards:
 - 1. American Society for Testing and Materials (ASTM):
 - a. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
 - 2. National Fire Protection Association (NFPA):
 - a. National Electric Code (NEC).
 - 3. Underwriters Laboratories, Inc. (UL):
 - a. 467, Electrical Grounding and Bonding Equipment.
 - 4. IEEE Standard:
 - a. 142, Recommended Grounding.

1.3 Submittals

- A. Shop Drawings:
 - 1. Grounding system details for:
 - a. Service entrance grounding.
 - b. Equipment grounding.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Wire and cable
 - i. As specified in Section 16120 except as modified in the following.
 2. Conduit
 - i. As specified in Section 16130.
 3. Ground rods
 - i. Thompson
 - ii. Joslyn
 - iii. Heary Brothers
 - iv. Or equal
 4. Grounding clamps and connectors
 - i. Thompson
 - ii. Burndy
 - iii. Heary Brothers
 - iv. Joslyn
 - v. Or equal

2.2 Components

- A. Wire and Cable
1. As specified in Section 16120 except as modified by the following.
 2. Grounding electrode conductor
 - a. Bare copper ground cable
 - i. Soft drawn stranded bare copper cable.
 - ii. ASTM B8.
 - b. Sized as required by Table 250-94 of the NEC, except where a larger size conductor is shown on the Contract Drawings.
 - i. Minimum conductor allowed: 1/0.
 3. Grounding conductor
 - a. Bare copper ground cable
 - i. Soft drawn stranded bare copper cable.
 - ii. ASTM B8.
 - b. 1/0 unless otherwise shown on Contract Drawings.
 4. Equipment grounding conductor
 - a. Green copper conductor: Identical insulation to phase conductors.

- b. Sized as required by Table 250-95 of the NEC, except where a larger size conductor is shown on the Contract Drawings.
- B. Conduit: As specified in Section 16130.
- C. Grounding Clamps
 - 1. High copper alloy content: Compression type
 - 2. UL 467 listed
 - 3. Noncorrosive
- D. Ground Rods:
 - 1. 3/4 IN x 10 FT, except as otherwise indicated on the Contract Drawings.
 - 2. Copperclad
 - a. Heavy uniform coating of electrolytic copper molecularly bonded to a rigid steel core.
 - b. Corrosion resistant bond between the copper and steel.
 - 3. Hard drawn for a scar-resistant surface.
 - 4. UL listed

PART 3 - EXECUTION

3.1 Installation

- A. General:
 - 1. Install products in accordance with manufacturer's instructions.
 - 2. Remove paint, rust, or other non-conducting material from contact surfaces before making ground connections.
 - 3. Where ground conductors pass through floor slabs or building walls, sleeves of intermediate metal conduit of the required size, shape, and length shall be provided, unless otherwise specified or shown on Drawings.
- B. Raceway Grounding-Conduit
 - 1. All metallic conduits shall be electrically continuous.
 - 2. Provide grounding-type insulating bushings:
 - a. For all equipment not supplied with a conduit hub.
 - b. On ends of metallic ductbank conduit.
 - 3. Bond all conduits, at entrance and exit of equipment, to equipment ground bus or ground lug.
 - 4. Use manufactured conduit hubs at all panels.
 - 5. Provide bonding jumpers if conduit are installed in concentric knockouts.

6. Make all metallic raceway fittings and grounding clamps tight to ensure equipment grounding system will operate continuously at ground potential to provide low impedance current path for proper operation of overcurrent devices during possible ground fault conditions.
7. Provide bonding jumper from equipment ground lug to Steel RMC conduit, if flexible conduit is utilized for equipment connections.
8. Provide bonding jumpers identical in conductor size to the largest ground conductor run within the conduit.

C. Equipment Grounding

1. Ground all voltage levels at the supply transformer from the secondary neutral to the ground grid. Provide two separate grounding conductors.
2. Provide a grounding conductor between the supply transformer and the grounding buses of all supplied MCCs and/or switchgear.
3. Ground all equipment supplied from an MCC or switchgear through the distribution equipment ground bus. Provide an equipment grounding conductor connected to the ground bus and equipment ground lug.
4. Provide two separate grounding conductors for bonding all MCC and switchgear ground buses to the ground grid.
5. Bond MCCs and/or switchgear fed from other distribution equipment to that equipment.
6. Bond 480-120/208 V AC transformers and lighting panels to the supplying MCC ground bus.
7. Ground all equipment fed from lighting panels through the lighting panel ground bus. Provide ground conductors for all connections.
8. Consider control devices (switches, indicating lights, meters, starters, relays, etc.) mounted in MCCs, switchgear, control panels, or other metal enclosures to be adequately grounded, if the enclosure ground lug or ground bus is properly grounded.
9. Do not splice grounding conductors.
10. Run all equipment grounding conductors in conduit.
11. Provide separate grounding conductors bonded to the ground grid for all DC equipment.
12. Provide a bare 1/0 conductor bolted to the motor frame and connected to the ground grid, for all motors 100 HP and larger.
13. Bond all lightning protection equipment to the ground grid.

14. Provide surge arresters for:
 - a. All communication cables entering or leaving a building.
 - b. Primary side of the service transformer.
15. Ground unused and spare power and control cable at both ends.

END OF SECTION

DIVISION 16

SECTION 16950

ACCEPTANCE, TESTING AND CALIBRATION

PART 1 - GENERAL

1.1 Description

- A. After electrical installation is complete, make tests to demonstrate that entire system is in proper working order and in accordance with applicable codes, manufacturer's instructions, drawings and specifications. Make no tests less than those outlined hereafter, unless requested in writing and approved by ENGINEER. Tests are in addition to, and no substitution for, tests of individual item at manufacturer's plant. Make insulation and ground resistance tests before operating tests. Determine proper rotation of motors before permanent connections are made.
- B. Tests are also intended to provide, ensure, or determine the following:
 - 1. Provide initial acceptance tests and recorded data that can be used as a benchmark for future routine maintenance and trouble shooting by plant operating forces.
 - 2. Ensure a successful start-up with a minimum of last minute interruptions and problems.
 - 3. Provide assurance that each system component is not only installed satisfactorily but performs, and will continue to perform, its function in the system with reasonable reliability throughout the life of the plant.
- C. It is the CONTRACTOR'S responsibility to provide all necessary supervision and labor, materials, tools, test instruments or other equipment or services and expenses required to test, adjust, set, calibrate, functionally and operationally check all work and components of the various electrical systems and circuitry throughout the installation. Also, the CONTRACTOR is to include the furnishing of sufficient personnel to assist operating forces in any additional checks they may require for acceptance, start-up, run-in and placing the equipment and systems into continuous service.
- D. CONTRACTOR shall complete tests and checks required to ensure proper operation and safety for equipment and personnel throughout the job, prior to final acceptance by the OWNER.
- E. CONTRACTOR shall pay all costs for tests including expenses incident to retests occasioned by defects and failures of equipment to meet specifications.
- F. CONTRACTOR shall replace wiring and equipment found defective, or failing to meet specified requirements, without charge, unless written acceptance for repair is given by ENGINEER.

1.2 Procedures and Schedules

- A. The CONTRACTOR is responsible for the preparation of proposed procedures and schedules for all inspections, tests, settings and calibrations specified or otherwise required prior to or during the check out for start-up and acceptance of all the electrical components, equipment and systems. This work to be coordinated and to be compatible with both the work of other crafts and the project schedule.

1.3 References and Standards

- A. All inspections and tests shall be in accordance with the following applicable codes and standards latest revisions except as provided otherwise herein.
1. All Standard, Special and Supplemental Conditions of the Contract.
 2. National Electrical Manufacturer's Association - NEMA.
 3. American Society for Testing and Materials - ASTM
 4. Institute of Electrical and Electronic Engineers - IEEE
 5. International Electrical Testing Association - NETA
 6. American National Standards Institute - ANSI
 - a. ANSI C2: National Electrical Safety Code
 - b. ANSI Z244-1: American National Standard for Personnel Protection
 7. State and Local Codes and Ordinances
 8. Insulated Cable Engineers Association - ICEA
 9. Association of Edison Illuminating Companies - AEIC
 10. Occupational Safety and Health Administration
 - a. OSHA Part 1910; Subpart S, 1910.308
 - b. OSHA Part 2916; Subpart V, 1926.950 through 1926.960
 11. National fire Protection Association - NFPA
 - a. ANSI/NFPA 70B: Electrical Equipment Maintenance
 - b. NFPA 70E: Electrical Safety Requirements for Employer Workplaces
 - c. ANSI/NFPA 70: National Electrical Code
 - d. ANSI/NFPA 78: Lightning Protection Code
 - e. ANSI/NFPA 101: Life Safety Code
- B. All inspections and tests shall utilize the following references:
1. Project Design Specifications
 2. Project Design Drawings
 3. Project Short Circuit and Coordination Study
 4. Manufacturer's instruction manuals applicable to each particular apparatus.

PART 2 - PRODUCTS

2.1 Testing Equipment

A. Calibration

1. The CONTRACTOR to furnish all the material, test equipment, and power sources required for testing, calibrating and check out. This test equipment to have calibrations traceable to the National Bureau of Standards. CONTRACTOR and/or testing laboratory dated calibration labels to be visible on all test equipment. The accuracy of all test instruments to be at least twice that of the accuracy of the equipment, device, relay or meter under test. All testing instruments to be checked to ensure satisfactory operation prior to proceeding with the tests. Serial and model numbers of the instruments used to be recorded on the test forms.

PART 3 - EXECUTION

3.1 Testing

- A. Make necessary openings in circuits for testing instruments and place and connect all instruments, equipment, and devices, necessary for the tests. Upon completion of tests, remove instruments and instrument connections and restore all circuits to permanent condition.
- B. Properly calibrate the chlorination system per MANUFACTURER'S guidelines.
- C. Check voltage on each connection to electrical device.
- D. Check all switches and disconnects for functionality.
- E. Startup and shutdown of all electrical devices.
- F. Check all electrical devices for proper operation per MANUFACTURER'S guidelines.

END OF SECTION