

SECTION 26 05 00 – ELECTRICAL WORK, GENERAL

PART 1 - GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide electrical work, complete and operable, in accordance with the Contract Documents.
- B. The provisions of this Section apply to all sections in Division 26, except as indicated otherwise.
- C. The WORK of this Section is required for operation of electrically-driven equipment provided under specifications in other Divisions. The CONTRACTOR's attention is directed to the requirement for proper coordination of the WORK of this Section with the WORK of equipment specifications, and the WORK of instrumentation sections.
- D. Concrete, excavation, backfill, and steel reinforcement required for encasement, installation, or construction of the WORK of the various sections of Division 26 is included as a part of the WORK under the respective sections, including duct banks, manholes, handholes, equipment housekeeping pads, and light pole bases.

1.2 REFERENCE STANDARDS

- A. The WORK of this Section and all sections in Division 26 shall comply with the following, as applicable:
 - NEC (NFPA 70) National Electrical Code
 - NETA International Electrical Testing Association
 - NEMA 250 Enclosure for Electrical Equipment (1000 Volts Maximum)Anchorage Electrical Code amendments to the NEC.
- B. Electrical equipment shall be listed by and shall bear the label of Underwriters' Laboratories, Inc. (UL).
- C. Installation of electrical equipment and materials shall comply with OSHA Safety and Health Standards, state building standards, and applicable local codes and regulations.
- D. Where the requirements of the specifications conflict with UL, NEMA, NFPA, or other applicable standards, the more stringent requirements shall govern.

1.3 SIGNAGE

- A. Local Disconnect Switches:
 - 1. Each local disconnect switch for motors and equipment shall be legibly marked to indicate its purpose, unless the purpose is indicated by the location and arrangement.
- B. Warning Signs:
 - 1. 600 volts nominal, or less. – Entrances to rooms and other guarded locations that contain live parts shall be marked with conspicuous signs prohibiting entry by unqualified persons.
- C. Isolating Switches: Isolating switches not interlocked with an approved circuit interrupting device shall be provided with a sign warning against opening them under load.

1.4 PUBLIC UTILITIES REQUIREMENTS

- A. The CONTRACTOR shall contact the serving utility and verify compliance with requirements before construction. The CONTRACTOR shall coordinate schedules and payments for work by all utilities.
- B. Electrical service shall be as indicated and be as required by the serving utility.
- C. The CONTRACTOR shall verify and provide all service conduits, fittings, grounding devices, and all service wires not provided by the serving utility.
- D. The CONTRACTOR shall verify with the utility the exact location of each service point and type of service, and shall pay all charges levied by the serving utilities as part of the WORK.

1.5 PERMITS AND INSPECTION

- A. All electrical permits shall be obtained and inspection fees shall be paid by the CONTRACTOR.
- B. All electrical permits shall be obtained by the CONTRACTOR. The OWNER has paid for the inspection fees.
- C. The CONTRACTOR shall pay all connection and turn-on service charges required by the utility company.

1.6 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with MASS Section 10.05 Article 5.6.
- B. Shop Drawings: Include the following:

1. Complete material lists stating manufacturer and brand name of each item or class of material.
 2. Shop Drawings for all grounding WORK not specifically indicated.
 3. Front, side, rear elevations, and top views with dimensional data.
 4. Location of conduit entrances and access plates.
 5. Component data.
 6. Connection diagrams, terminal numbers, internal wiring diagrams, conductor size, and cable numbers.
 7. Method of anchoring, seismic requirements, weight.
 8. Types of materials and finish.
 9. Nameplates.
 10. Temperature limitations, as applicable.
 11. Voltage requirement, phase, and current, as applicable.
 12. Front and rear access requirements.
 13. Test reports.
 14. Grounding requirements.
 15. Catalog cuts of applicable pages of bulletins or brochures for mass produced, non-custom manufactured material. Catalog data sheets shall be stamped to indicate the project name, applicable Section and paragraph, model number, and options. This information shall be marked in spaces designated for such data in the ENGINEER's stamp.
- C. Shop Drawings shall be custom prepared. Drawings or data indicating "optional" or "as required" equipment are not acceptable. Options not proposed shall be crossed out or deleted from Shop Drawings.
- D. Materials and Equipment Schedules: The CONTRACTOR shall deliver to the ENGINEER within 30 days of the commencement date in the Notice to Proceed, a complete list of all materials, equipment, apparatus, and fixtures proposed for use. The list shall include type, sizes, names of manufacturers, catalog numbers, and other such information required to identify the items.
- E. Owner's Manuals: Complete information in accordance with MASS Section 10.04, Article 4.20 Operating and Maintenance Manuals.
- F. Record Drawings: The CONTRACTOR shall show invert and top elevations and routing of all duct banks and concealed below-grade electrical installations. Record Drawings shall be prepared, be available to the ENGINEER, and be submitted according to MASS Section 10.05 Article 5.6.
- G. Equipment Summary Sheets: The CONTRACTOR shall provide Electrical Equipment Summary Form 1302 CM 1207 for all electrical devices, panels, motor starters, and miscellaneous equipment. The data shall be provided in electronic format, **Microsoft Excel**, or approved equal.

1.7 AREA DESIGNATIONS

A. General:

1. Raceway system enclosures shall comply with Section 26 05 33 – Electrical Raceway Systems.
2. Electrical WORK specifically indicated in sections within any of the Specifications shall comply with those requirements.
3. Electrical WORK in above ground indoor facilities shall be NEMA 12.
4. Electrical WORK in below ground facilities and outdoors shall be NEMA 4X.
5. Installations in hazardous locations shall conform strictly to the requirements of the Class, Group, and Division indicated.

B. Material Requirements:

1. NEMA 4X enclosures shall be stainless steel.
2. NEMA 12 enclosures shall be steel, coated with ANSI 61 grey paint.

1.8 TESTS

- A. The CONTRACTOR shall be responsible for factory and field tests required by specifications in Division 26 and by the ENGINEER or other authorities having jurisdiction. The CONTRACTOR shall furnish necessary testing equipment and pay costs of tests, including all replacement parts and labor, due to damage resulting from damaged equipment or from testing and correction of faulty installation.
- B. Where test reports are indicated, proof of design test reports for mass-produced equipment shall be submitted with the Shop Drawings, and factory performance test reports for custom-manufactured equipment shall be submitted and be approved prior to shipment. Field test reports shall be submitted for review prior to Substantial Completion.
- C. Equipment or material which fails a test shall be removed and replaced.

1.9 DEMOLITION AND RELATED WORK

- A. The CONTRACTOR shall perform electrical demolition WORK as indicated on the electrical drawings and in parts of this Specification Section. The CONTRACTOR is cautioned that demolition WORK may also be indicated on non-electrical drawings. Coordinate electrical de-energization, disconnection, and removal with all trades and the overall sequence of construction.
- B. Electrical requirements associated with removed equipment shall be:
 1. Remove control and signal wiring as indicated.
 2. Remove all abandoned raceways.
 3. Encased conduits shall be cut flush to the floor and be grouted.
 4. Remove remote mounted starters, disconnect switches, circuit breakers, sensors, and transmitters.

5. Remove remote mounted status lights and switches where indicated on the electrical drawings, and blank off openings in existing panels with field-fabricated stainless steel plates. Plates shall be attached with stainless steel finish screws.
 6. Remove control panels, equipment sheds, and concrete bases and posts for panels and sheds.
 7. Pump cords, level sensors, level switches.
- C. Where new lighting and receptacles are installed, old lighting, receptacles, switches, wiring, and conduits shall be removed.
 - D. Raceways to be reused or extended shall be terminated in a new junction box. The junction box shall have a NEMA rating in accordance with the area in which it is located and shall be sized as required.
 - E. Materials and equipment not indicated to be removed and returned to the OWNER shall, upon removal, become the CONTRACTOR's property and shall be disposed of off-site.
 - F. Material and equipment indicated to be relocated or reused shall be removed and relocated, and reinstalled with care to prevent damage thereto.
 - G. Materials indicated to be returned to the OWNER shall be placed in boxes with the contents clearly marked and be stored at a location determined by the ENGINEER.
 - H. Where MCCs or panelboards are indicated to have circuits removed and reconnected, the MCC shall have a new engraved phenolic nameplate worded as indicated, and the panelboard schedule shall be modified to indicate the revised circuits. Pencil or magic marker markings directly on the MCC or panelboard breaker are not permitted.

1.10 CONSTRUCTION SEQUENCING

- A. Continuance of facility operation during demolition and the installation process is critical at some facilities. Therefore, the CONTRACTOR shall carefully examine all work to be done in, on, or adjacent to existing equipment. Work shall be scheduled, subject to the OWNER's approval, to minimize required process or equipment shutdown time. The CONTRACTOR shall submit a written request including sequence and duration of activities to be performed during plant shutdown.
- B. All switching, safety tagging, etc., required for process or equipment shutdown or to isolate existing equipment shall be performed by the CONTRACTOR. In no case shall the CONTRACTOR begin any work in, on, or adjacent to existing equipment without written authorization by the AWWU plant supervisor and the ENGINEER. The CONTRACTOR shall remove the lock within 4 hours upon request of AWWU, in an emergency, and if the equipment is operable.
- C. The CONTRACTOR shall make all modifications or alterations to existing electrical facilities required to successfully install and integrate the new electrical equipment as indicated on the electrical drawing. Modifications to existing equipment, panels, or

cabinets shall be made in a professional manner with all coatings repaired to match existing. The CONTRACTOR is responsible for ensuring all panels and equipment are UL-listed. The costs for modifications (including UL listing) to existing electrical facilities required for a complete and operating system shall be included in the CONTRACTOR's original Bid amount and no additional payment for this WORK will be authorized. Extreme caution shall be exercised by the CONTRACTOR in digging trenches in order not to damage existing underground utilities. Cost of repairs of damages caused during construction shall be the CONTRACTOR's responsibility without any additional compensation from the OWNER.

- D. The CONTRACTOR shall be responsible for identifying available existing circuit breakers in lighting panels for the intended use as required by the Drawings. The CONTRACTOR shall also be responsible for field-verifying the available space in substation switchboards to integrate new power circuit breakers. Costs for this WORK shall be included in the CONTRACTOR's original Bid amount.
- E. The CONTRACTOR is advised to visit the Site before submitting a Bid to better acquaint itself with the WORK of this Contract. Lack of knowledge will not be accepted as a reason for granting extra compensation to perform the WORK.
- F. Installation of New Equipment:
 - 1. The CONTRACTOR will install and terminate the new switchboards, motor starters, control panels, wireways, cables, and instruments in accordance with the agreed schedule. The CONTRACTOR shall provide a list, daily, of the points that are ready for service as they are connected, calibrated, and tested. The CONTRACTOR shall only connect to equipment that is new or is out of service.
 - 2. The recommended construction sequence is as follows:
 - a. Remove all demolition items and make good all surfaces before applying appropriate surface finish and paint.
 - b. Install new switchboards, motor starters, SCADA panels and instruments.
 - c. Install new raceways between switchboards, motor starters, instruments, and new SCADA panel.
 - d. Install all new wiring as specified.
 - e. Complete wiring modifications to existing equipment.
 - 3. The recommended construction sequence for those stations where the a new Pump Station Control Panel is not displacing the existing panel is as follows:
 - a. Install the new concrete base, Pump Station Control Panel, and instruments.
 - b. Run new conduit and wire.
 - c. Energize the Pump Control Panel and test radio communications.
 - d. Test remote alarms.
 - e. Remove the power cable from first pump, install new power cable, connect to pump control panel and test operation.
 - f. Remove the power cable from second pump, install new power cable, connect to pump control panel and test operation.
 - g. Remove old pump control panel, meter base, and remaining conduit and wire.

4. The recommended construction sequence for those stations where the existing Pump Station Panel is being displaced and must be removed before the new panel can be installed:
 - a. Provide and schedule a pumping truck to pump the station as required.
 - b. Remove the existing Pump Control Panel, meter base, pump cords, and conduit and wire.
 - c. Install the new concrete base, Pump Station Control Panel, and instruments.
 - d. Run new conduit and wire.
 - e. Energize the Pump Control Panel and test radio communications.
 - f. Test remote alarms.
 - g. Remove the power cable from all pumps, install new power cable, connect the pumps to the Control Panel and test operation.
5. Allowable down time requirements: The CONTRACTOR shall minimize the amount of time a facility is out of service as required by this table:

Site	Allowable Down Time	Estimated Influent

6. The CONTRACTOR shall sequence the WORK so that only two (2) sites at any one time are in temporary condition where only one pump is connected to the new panel or the station is being discharged by a pump truck.
7. Minimum down time Requirements: The CONTRACTOR shall minimize the amount of time a facility is out of service. The CONTRACTOR shall provide the ENGINEER with an estimate of the amount of time a facility will be out of service.
8. The ENGINEER will coordinate with the CONTRACTOR to load and commission the PLC software after the CONTRACTOR makes the wiring modifications.
9. The OWNER shall take beneficial occupancy of each facility as the WORK is signed off.
 - a. Warranty: The warranty shall start from the date of final acceptance of the completed project, and shall extend for 1 year, in accordance with MASS Division 10.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Equipment and materials shall be new, shall be listed by UL, and shall bear the UL label where UL requirements apply. Equipment and materials shall be the products

of experienced and reputable manufacturers in the industry. Similar items in the WORK shall be products of the same manufacturer. Equipment and materials shall be of industrial grade standard of construction.

- B. Where a NEMA enclosure type is indicated in a non-hazardous location, the CONTRACTOR shall utilize that type of enclosure, despite the fact that certain modifications, such as cutouts for control devices, may negate the NEMA rating.
- C. On devices indicated to display dates, the year shall be displayed as 4 digits.

2.2 MOUNTING HARDWARE

- A. Miscellaneous Hardware:
 - 1. Nuts, bolts, and washers shall be stainless steel.
 - 2. Threaded rods for trapeze supports shall be continuous-threaded, galvanized steel, 3/8-inch diameter minimum.
 - 3. Strut for mounting of raceways and equipment shall be galvanized or stainless steel as required by the area classification. Where contact with concrete or dissimilar metals may cause galvanic corrosion, suitable non-metallic insulators shall be utilized to prevent such corrosion. Strut shall be as manufactured by **Unistrut, B-Line**, or equal.
 - 4. Anchors for attaching equipment to concrete walls, floors and ceilings shall be stainless steel expansion anchors, such as "**Rawl-Bolt**," "**Rawl-Stud**" or "**Lok-Bolt**" as manufactured by **Rawl**; similar by **Star**, or equal. Wood plugs shall not be permitted.

2.3 ELECTRICAL IDENTIFICATION

- A. Nameplates: Nameplates shall be fabricated from black-letter, white-face laminated plastic engraving stock, **Formica type ES-1**, or equal. Each shall be fastened securely, using fasteners of brass, cadmium-plated steel, or stainless steel, screwed into inserts or tapped holes, as required. Engraved characters shall be block style, with no characters smaller than 1/8-inch in height.
- B. Conductor and Equipment Identification: Conductor and equipment identification devices shall be heat-shrink plastic tubing with machine printing. Lettering shall read from left to right and shall face toward the front of the panel.

PART 3 - EXECUTION

3.1 GENERAL

- A. Incidentals: The CONTRACTOR shall provide all materials and incidentals required for a complete and operable system, even if not required explicitly by the Specifications or the Drawings. Typical incidentals are terminal lugs not furnished with vendor-supplied equipment, compression connectors for cables, splices, junction

and terminal boxes, and control wiring required by vendor-furnished equipment to connect with other equipment indicated in the Contract Documents.

- B. Field Control of Location and Arrangement: The Drawings diagrammatically indicate the desired location and arrangement of outlets, conduit runs, equipment, and other items. Exact locations shall be determined by the CONTRACTOR in the field, based on the physical size and arrangement of equipment, finished elevations, and other obstructions. Locations on the Drawings, however, shall be followed as closely as possible.
1. Where raceway development drawings, or "home runs," are shown, the CONTRACTOR shall route the raceways in accordance with the indicated installation requirements. Routings shall be exposed.
 2. Conduit and equipment shall be installed in such a manner as to avoid all obstructions and to preserve headroom and keep openings and passageways clear. Lighting fixtures, switches, convenience outlets, and similar items shall be located within finished rooms as indicated. Where the Drawings do not indicate exact locations, the ENGINEER shall determine such locations. If equipment is installed without instruction and must be moved, it shall be moved without additional cost to the OWNER. Lighting fixture locations shall be adjusted slightly to avoid obstructions and to minimize shadows.
 3. Wherever raceways and wiring for lighting and receptacles are not indicated, it shall be the CONTRACTOR's responsibility to provide all lighting and receptacle-related conduits and wiring as required, based on the actual installed fixture layout and the circuit designations as indicated. Wiring shall be #12 AWG minimum, and conduits shall be 3/4-inch minimum. Where circuits are combined in the same raceway, the CONTRACTOR shall derate conductor ampacities in accordance with NEC requirements.
 4. Where complete raceway systems are not shown on the plans, Contractor shall submit a raceway plan for approval. Intent is to minimize number of raceway systems.
- C. MOA NEC Local Amendments: The CONTRACTOR shall comply with all requirements of the MOA NEC local amendments.
1. The CONTRACTOR shall pay particular attention to the additional grounding requirements. In general, grounding conductors are not specifically called out on the drawings but are required for every raceway.
- D. Workmanship: Materials and equipment shall be installed in strict accordance with printed recommendations of the manufacturer. Installation shall be accomplished by workers skilled in the work. Installation shall be coordinated in the field with other trades to avoid interferences.
- E. Protection of Equipment and Materials: The CONTRACTOR shall fully protect materials and equipment against damage from any cause. Materials and equipment, both in storage and during construction, shall be covered in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint. Moving parts shall be kept clean and dry. The CONTRACTOR shall replace or refinish damaged materials or equipment, including faceplates of panels and switchboard sections, as part of the WORK.

- F. Incoming utility power equipment shall be provided in conformance with the utility's requirements.
- G. The CONTRACTOR shall provide power wiring in raceways for the motor starters in accordance with Section 26 24 19 – Low Voltage Motor Control Center, for starters in MCC's and Section 25 14 05 – Local Control Stations and Miscellaneous Electrical Devices, for starters not in MCC's.

3.2 CORE DRILLING

- A. The CONTRACTOR shall perform core drilling required for installation of raceways through concrete walls and floors. Locations of floor penetrations, as may be required, shall be based on field conditions. Verify all exact core drilling locations based on equipment actually furnished, as well as exact field placement. To the extent possible, identify the existence and locations of encased raceways and other piping in existing walls and floors with the OWNER prior to any core drilling activities. Damage to any encased conduits, wiring, and piping shall be repaired as part of the WORK.
- B. All penetrations required to extend raceways through concrete walls, roofs, and floors or masonry walls shall be core drilled.

3.3 CONCRETE HOUSEKEEPING PADS

- A. Concrete housekeeping pads shall be provided for indoor floor standing electrical equipment. Housekeeping pads for equipment, including future units, shall be 3-1/2 inches above surrounding finished floor or grade, and 2 inches larger in both dimensions than the equipment, unless otherwise indicated.
- B. Concrete housekeeping curbs shall be provided for all conduit stub-ups in indoor locations that are not concealed by equipment enclosures. Such curbing shall be 3 inches above finished floor or grade.

3.4 EQUIPMENT ANCHORING

- A. Floor supported, wall-, or ceiling-hung equipment and conductors shall be anchored in place by methods that will meet seismic requirements in the area where the project is located. Wall-mounted panels that weigh more than 500 pounds, or which are within 18 inches of the floor, shall be provided with fabricated steel support pedestals. If the supported equipment is a panel or cabinet enclosed within removable side plates, it shall match supported equipment in physical appearance and dimensions. Transformers hung from 4-inch stud walls and weighing more than 300 pounds shall have auxiliary floor supports.
- B. Anchoring methods and leveling criteria in the printed recommendations of the equipment manufacturers are a part of the WORK of this Contract. Such recommendations shall be submitted as Shop Drawings under MASS Section 10.05 Article 5.6.

- C. Panels, raceways, and other equipment shall be anchored and supported for Seismic requirements of MOA Building Safety.

3.5 EQUIPMENT IDENTIFICATION

- A. General: Equipment and devices shall be identified as follows:
 - 1. Nameplates shall be provided for all panelboards, control and instrumentation panels, starters, switches, and pushbutton stations. In addition to nameplates, control devices shall be equipped with standard collar-type legend plates.
 - 2. Control devices within enclosures shall be identified as indicated. Identification shall be similar to the subparagraph above.
 - 3. Equipment names and tag numbers, where indicated on the Drawings, shall be utilized on all nameplates.
 - 4. The CONTRACTOR shall furnish typewritten circuit directories for panelboards; circuit directory shall accurately reflect the equipment connected to each circuit.
 - 5. Generator receptacles shall be identified with the incoming service voltage with 1" lettering.
 - 6. Generator transfer switches shall be labeled "Main" and "Generator" with ½" lettering.

3.6 CLEANING

- A. Before final acceptance, the electrical WORK shall be thoroughly cleaned. Exposed parts shall be thoroughly clean of cement, plaster, and other materials. Oil and grease spots shall be removed with a non-flammable cleaning solvent. Such surfaces shall be carefully wiped and all cracks and corners cleaned out. Touch-up paint shall be applied to scratches on panels and cabinets. Electrical cabinets or enclosures shall be vacuum-cleaned.
- B. CONTRACTOR shall group, coil, and tie wrap all spare cables at the bottom of the Local Control Panels. The wires shall be grouped according to the device, control panel, or MCC section they originate from. Cable groups shall be tagged according to their point of origin.
- C. All debris shall be removed from the void below the panels.

3.7 CONTROL PANEL WIRING

- A. The CONTRACTOR shall ensure all panels are UL-listed upon completion of the WORK.

END OF SECTION 26 05 00