

SECTION 260000

ELECTRICAL – GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SCOPE

- A. The Contractor shall be responsible to furnish all labor, material and equipment required for the work performed.
- B. Furnish all labor, materials, equipment and incidentals required and install complete and make operational electrical systems as shown on the Drawings and as specified herein.
- C. Coordinate the sequence of demolition with the sequence of construction to maintain plant operation in each area. Remove and demolish equipment and materials in such a sequence that the existing plant will function properly with no disruption of treatment.
- D. Each bidder or their authorized representatives shall, before preparing their proposal, visit all areas of the existing buildings and structures in which work under this bid is to be performed and inspect carefully the present installation. The submission of the proposal by this bidder shall be considered evidence that they have visited the site, buildings and structures and noted the locations and conditions under which the work will be performed and that they take full responsibility for a complete knowledge of all factors governing his/her work.
- E. All power interruptions to electrical equipment shall be at the Owner's convenience with 72 hours (minimum) notice. Each interruption shall have prior approval.
- F. Contractor shall provide their own temporary power for miscellaneous power (drills, pumps, etc.). No facility circuits shall be used unless approved in writing by the Engineer. Any temporary power added shall be removed at job completion.
- G. The work includes but is not limited to the following:
 - 1. Removal of existing Pump Control Panel and installation of a new Pump Control Panel, TCU Cabinet and all associated wire, conduit, control devices, terminal cabinets, safety disconnect switch, boxes and mounting racks etc. and at each location as indicated on the drawings and in the project specifications.

2. Connection of new or existing pumps and floats to the new Pump Control Panel and pump cable termination cabinet. Provide new wire and conduit as required.
3. Any and all electrical work associate with installation of new pumps and pump cables, floats etc.to existing Pump Control Panel as indicated on the drawings or in section 011000 Summary of Work.
4. Coordination with local power company (FPL) for modifications to existing services at each location as needed. Pay all FPL fees to disconnect existing service, reconnect existing service or provide new service including conductors, conduit, boxes and appurtenances as needed and described on the drawings and in section 011000 Summary of Work. Electric power meter to include the aluminum enclosure.
5. Interconnection of equipment provided under other specification sections including SCADA/TCU equipment.
6. Complete testing of all equipment and wiring at the completion of work and making any minor correction changes or adjustments necessary for the proper functioning of the system and equipment. All workmanship shall be of the highest quality; substandard work will be rejected.

1.2 SUBMITTALS

- A. Submit to the Engineer in accordance with Section 013000, shop drawings for equipment, materials and other items furnished on this project. The term “shop drawing” as used herein includes qualifications, installation and layout drawings, manufacturer’s drawings, diagrams, descriptive literature, catalogs and brochures, performance and test data, and all other items required to show that the materials, equipment, personnel and methods conform to the Contract requirements.
- B. Shop drawings shall be submitted for the following materials and equipment:
 1. Raceways, Boxes, Fittings and Hangers
 2. Wires and Cables
 3. Circuit Breakers
 4. Miscellaneous Equipment
 5. Grounding Hardware and Connections

6. Control Panels

- C. Submittal shall be required for the following items:
1. Concealed and exposed conduit layouts
 2. Equipment locations
- D. Check shop drawings for accuracy and contract requirements prior to submittal. Shop drawing transmittal shall include the date checked and a certification 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.
- E. 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.
- F. All dimensions shall be field verified at the job site and coordinated with the work of all other trades.
- G. The Engineer shall review shop drawings and provide a review designation. Material shall not be ordered or shipped until the shop drawings have been approved. No material shall be ordered or shop work started if shop drawings are marked "APPROVED AS NOTED - CONFIRM," "APPROVED AS NOTED - RESUBMIT" or "NOT APPROVED."
- H. Approval of shop drawings shall not be construed as authorizing additional work or increased cost to the Owner. Approval action shall not relieve the Contractor from responsibility for error or for the proper fitting and construction of the work. Approval shall not relieve the Contractor from responsibility for omissions which may exist on the shop drawings, or for furnishing of materials or work required by the contract and not indicated on shop drawings, unless these items are specifically mentioned in the submittal letter. Where errors or omissions are discovered later, they must accordingly be made good by the Contractor irrespective of any approvals.
- I. All corrections required by the Engineer shall not delay committed delivery dates.

1.3 REFERENCED STANDARDS (LATEST REVISION)

A. Electric equipment, materials and installation shall comply with the latest edition of the National Electrical Code (NEC) and with the latest edition of the following codes and standards:

1. National Electrical Safety Code (NESC)
2. Occupational Safety and Health Administration (OSHA)
3. National Fire Protection Association (NFPA)
4. National Electrical Manufacturers Association (NEMA)
5. American National Standards Institute (ANSI)
6. Insulated Cable Engineers Association (ICEA)
7. International Society of Automation (ISA)
8. Underwriters Laboratories (UL)
9. Factory Mutual (FM)
10. International Electrical Testing Association (NETA)
11. Institute of Electrical and Electronic Engineers (IEEE)

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 PRIORITY OF THE CONTRACT DOCUMENTS

A. If, during the performance of the work, the Contractor finds a conflict, error or discrepancy between or among one or more of the Sections or between or among one or more Sections and the Drawings, furnish the higher performance requirements. The higher performance requirement shall be considered the equipment, material, device or installation method which represents the most stringent option, the highest quality or the largest quantity.

B. In all cases, figured dimensions shall govern over scaled dimensions, but work not dimensioned shall be as directed by the Engineer and work not particularly shown, identified, sized, or located shall be the same as similar work that is shown or specified.

C. Detailed Drawings shall govern over general drawings, larger scale Drawings take precedence over smaller scale Drawings, Change Order Drawings shall govern over Contract Drawings and Contract Drawings shall govern over Shop Drawings.

- D. If the issue of priority is due to a conflict or discrepancy between the provisions of the Contract Documents and any referenced standard, or code of any technical society, organization or association, the provisions of the Contract Documents will take precedence if they are more stringent or presumptively cause a higher level of performance. If there is any conflict or discrepancy between standard specifications, or codes of any technical society, organization or association, or between Laws and Regulations, the higher performance requirement shall be binding on the Contractor, unless otherwise directed by the Engineer.
- E. In accordance with the intent of the Contract Documents, the Contractor accepts the fact that compliance with the priority order specified shall not justify an increase in Contract Price or an extension in Contract Time nor limit in any way, the Contractor's responsibility to comply with all Laws and Regulations at all times.

1.5 CODES, INSPECTIONS, AND FEES

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

1.6 SERVICE AND METERING

- A. The power company serving this project is Florida Power and Light (FPL). Service will be obtained at voltage and phase as indicated on the drawings from the utility transformer to the service entrance equipment as shown on the drawings. Contractor will coordinate with Power Company for both temporary and permanent service.

1.7 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. Record drawings shall accurately show the installed condition of the following items:
 - 1. One-line Diagram(s).
 - 2. Raceways and pullboxes.
 - 3. Conductor sizes and conduit fills.
 - 4. Plan view, sizes and locations of electrical equipment.

1.8 INTERPRETATION OF DRAWINGS

- A. The Drawings are not intended to show exact locations of conduits run, but general routing. The Contractor shall be responsible for exact routing all conduits.
- B. All necessary fittings and boxes shall be provided for a complete raceway installation.
- C. Where intended routing of raceways interferes with existing lights, equipment or conduits, relocation and re-routing shall be the responsibility of the Contractor at no additional cost to the Owner.
- D. It is the intent of these Specifications that the Electrical Systems shall be suitable in every way for the service required. All materials and all work that may be implied as being incidental to the work of this Section shall be furnished at no additional cost to the Owner.

1.9 MATERIALS AND EQUIPMENT

- A. Materials and equipment shall be new, except where specifically identified on the Drawings to be re-used.
- B. Material and equipment of the same type shall be the product of one manufacturer.
- C. All electrical equipment and materials shall be listed by Underwriter's Laboratories, Inc., and shall bear the appropriate UL listing mark or classification marking. Equipment, materials, etc. utilized not bearing a UL certification shall be field or factory UL certified prior to equipment acceptance and use.
- D. Warrant all equipment and workmanship for a period of one year after substantial completion.

1.10 ENCLOSURE TYPES

- A. Unless otherwise specified, electrical enclosures shall have the following ratings:
 - 1. NEMA 4X stainless steel for all locations.

1.11 DEMOLITION

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

- B. Remove unused exposed conduit and wiring back to point of concealment. Remove unused wiring in concealed conduits back to source (or nearest point of usage).
- C. Disconnect and remove abandoned panelboards, transformers, disconnect switches, control stations, distribution equipment, etc.
- D. Disconnect electrical circuits in the way of demolition work and re-establish circuits to remaining outlets, fixtures, equipment, etc.
- E. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits. Use personnel experienced in such operations.
- F. New lighting shall be in place or safe lighting levels maintained for plant operation during the construction period.
- G. Repair adjacent construction and finishes damaged during demolition and extension work.
- H. Where electrical systems pass through the demolition areas to serve other portions of the premises, they shall remain or be suitably relocated and the system restored to normal operation.
- I. 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.
- J. Removal and relocation of existing conduit, wire and equipment have not been detailed on the Drawings. Survey the affected areas before submitting bid proposal.
- K. 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.
- L. Remove exposed conduits, wireways, outlet boxes, pull boxes and hangers made obsolete by the alterations, unless specifically designated to remain. Patch surfaces and provide stainless steel blank covers for abandoned outlets which are removed.
- M. Electrical Removal
 - 1. All existing electrical equipment to be removed shall be removed with such care as may be required to prevent unnecessary damage, to keep

existing systems in operation and to maintain the integrity of the grounding systems.

2. Conduits and wires shall be abandoned or removed where shown. All wires in abandoned conduits shall be removed, salvaged and stored. Abandoned conduits concealed in slabs, shall be cut flush with the slab at the point of entrance. The conduits shall be suitably plugged and the area repaired in a flush, smooth and approved manner. Exposed conduits and their supports shall be disassembled and removed from the site. Repair all areas of work to prevent rust spots on exposed surfaces.

1.12 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. Any fees or charges incurred for disposal of such equipment or materials shall be paid by the Contractor. A receipt showing acceptable disposal of any legally regulated materials or equipment shall be given to the Owner.

PART 2 - PRODUCTS

2.1 RACEWAYS, BOXES, FITTINGS, AND SUPPORTS

- A. Rigid Steel Conduit (NEC Type RMC)
 1. Rigid steel conduit (RSC) also referred to as galvanized rigid steel (GRS) conduit, couplings, factory elbows and fittings shall be hot-dipped galvanized and as manufactured by the Allied Tube and Conduit Corp., Wheatland Tube Co., or equal.
 2. Rigid steel conduit shall be galvanized after threading.
 3. Rigid steel conduit shall be for use under the provisions of NEC Article 344.
- B. BOXES AND FITTINGS
 1. NEMA 4X junction boxes, pull boxes, etc., shall be Type 316 stainless steel with 316 stainless steel hardware and gasketed covers, unless specified otherwise. Boxes shall have continuously welded seams and welds shall be ground smooth. Boxes shall be flanged and shall not have holes or knockouts. Box bodies and covers shall not be less than 14-gauge metal. Covers shall be gasketed, hinged, and fastened with quick connect door clamp. Boxes shall be as manufactured by Hoffman Engineering Co.; Lee Products Co.; Keystone/Rees, Inc., or equal.

2. Conduit hubs shall be of the grounding type as manufactured by Myers Electric Products, Inc. or equal.
3. Conduit wall seals for cored holes shall be Type CSML as manufactured by the O.Z./Gedney Co. or equal.
4. Conduit wall and floor seals for sleeved openings shall be Type CSMI as manufactured by the O.Z./Gedney Co. or equal.

C. CONDUIT MOUNTING EQUIPMENT

1. 316 Stainless steel channel with 316 stainless steel hardware (hangers, rods, backplates, beam clamps, fasteners, anchors, nuts, washers, etc.) shall be used outdoors.
2. Expansion anchors (minimum 3/8" diameter) shall be equal to Kwik Bolt as manufactured by the McCulloch Industries, Minneapolis, MI; Wej it by Wej it Expansion Products, Inc., Bloomfield, CO; or Kwik-Bolt II as manufactured by the Hilti Fastening Systems, Inc, Tulsa, OK. The length of expansion bolts shall be sufficient to place the wedge portion of the bolt a minimum of 1 in behind the steel reinforcement. Apply anti-seize compound to all nuts and bolts. Supports installed without the approved compound shall be dismantled and correctly installed, at no cost to the Owner.

D. MISCELLANEOUS RACEWAY MATERIALS

1. Wall and floor slab openings shall be sealed with "FLAME SAFE" as manufactured by the Thomas & Betts Corp.; Pro Set Systems; Neer Mfg. Co.; Specified Technologies, Inc. or equal.
2. Cold galvanizing compound shall be 95% zinc rich paint as manufactured by ZRC Products Company, a Division of Norfolk Corp. or equal.

2.2 WIRE, CABLES, AND ACCESSORIES

- A. Wires and cables shall be of annealed, 98 percent conductivity, soft drawn copper, stranded.
- B. Wire shall be 600V rated with NEC type XHHW-2 for No. 4/0 AWG and smaller and NEC type RHW-2 for No. 250 kcmil and larger.
- C. Bare copper ground wire shall be stranded, tinned soft or annealed copper electrical wire ASTM B33.
- D. Equipment grounding conductors shall be green and sized in

accordance with NEC Table 250.122 unless noted otherwise on the drawings.

- E. All wire of a given type shall be the product of a single manufacturer.
- F. Acceptable manufacturers: Service Wire, Southwire, General Cable, or Equal.
- G. Terminations and Splices (Power Conductors)
 - 1. Unless otherwise indicated on the plans, no splices may be made in the cables without prior written approval of the Engineer. Where splicing is approved, then splicing material shall be approved by the Engineer and cable manufacturer. Splicing materials for all 600-volt splices shall be made with long barrel tin plated copper compression (hydraulically pressed) connectors and insulated with heavy wall heat shrinkable tubing. The conductivity of all completed connections shall be not less than that of the uncut conductor. The insulation resistance of all completed connections of insulated conductors shall be not less than that of the uncut conductor.

2.3 SAFETY DISCONNECT SWITCHES

A. DISCONNECT SWITCHES

- 1. Disconnect switches shall be heavy duty, quick make, quick break, visible blades, 600 Volt, 3 Pole with full cover interlock, interlock defeat and flange mounted operating handle unless otherwise noted. Enclosure type shall be as noted on the drawings. All current carrying parts shall be copper.
- 2. NEMA 4X enclosures shall be stainless steel.
- 3. NEMA 7 enclosures shall be cast aluminum.
- 4. Lugs shall be copper.
- 5. All exterior hardware shall be stainless steel.
- 6. Switches shall be as manufactured by Eaton, Schneider Electric/Square D or General Electric.

B. FUSED DISCONNECT SWITCHES

- 1. Fused disconnect switches shall be NEMA 4X heavy duty, quick make, quick break, visible blades, 600 Volt, 3 Pole with full cover interlock,

interlock defeat and flange mounted operating handle unless otherwise noted. All current carrying parts shall be copper.

2.4 PUMP CONTROL PANEL

A. The Contractor shall provide a complete and fully functional control system to manually or automatically operate the control system as specified herein and in other applicable sections of these specifications. All manufacturers recommended safety devices shall be furnished to protect operators. All control devices, unless specified otherwise, shall be mounted in the Control Panel.

B. CONTROL PANEL CONSTRUCTION ON OPERATION

1. The control panel shall respond to liquid level float switches to automatically start and stop pumps, as well as sound an alarm upon high or low wet well levels. The control panel shall operate two (2) electrical submersible pumps at the power characteristics stipulated. The control function shall provide for the operation of the lead pump under normal conditions. If the incoming flow exceeds the pumping capacity of the lead pump, the lag pump shall automatically start to handle this increased flow. As the flow decreases, the pumps shall be cutoff at the specified elevation. The pumps shall alternate positions as lead pump at the end of each cycle. A failure of the alternator shall not disable the pumping system. The alternator shall include a safe, convenient method of manual alternation and also have provisions to prevent automatic alternation without disturbing any wiring. Should the "pump off" regulator fail, the system shall keep the station in operation and provide a visual indication of the regulator failure.
 - a. The control panel shall consist of main circuit breakers and generator breaker with mechanical interlock, an emergency power receptacle, a circuit breaker and magnetic starter for each pump motor, and 15 ampere, 120-volt circuit breakers as required. All pump control operations shall be accomplished by a float type liquid level control system with all control components mounted in one (1) common enclosure. Control switches shall provide means to operate each pump manually or automatically. When operated in the automatic mode, the control assembly shall provide means to manually select or automatically alternate the position of the "lead" and "lag" pumps after each pumping cycle. A float type liquid level control system shall continuously monitor wet well liquid level and control operation of the low-level cutoff for the pumps and shall operate off a 24-volt circuit.
2. Panel Construction: The panel shall be housed in a NEMA 4X, Type 304, 14-gauge stainless steel enclosure with 30 percent extra mounting space for additional equipment. The enclosure shall have provisions for

padlocking the door and a dead front inner door unit for mounting controls. All exterior hardware and hinges shall be stainless steel. In addition, there shall be permanently affixed to the interior side of the exterior door both a nameplate and a 10-inch by 12-inch pocket for log sheet storage. The nameplate shall contain the following information: voltage, phase, rated horsepower, speed, date manufactured and pump and control panel manufacturer's name, address and telephone number, pump date, including impeller data, operating point and head, KW input, and amps at the operating point and at least two (2) other points on the pump curve. Provide space inside the panel box to accommodate installation of an 8" x 8" x 10" telemetry unit (coordinate with NPU).

3. Power Supply and Main Disconnect: The power supply to the control panel shall be 240-volt, 3 phase, 4 wire or 480 volt, 3-phase, 4 wire. Minimum service shall be 100-amp. Single-phase power shall not be accepted. A fusible safety service main disconnects shall be installed at all stations. In all 240-volt systems, disconnects should be installed between the meter and the panel, and on all 480 volt systems disconnect should be installed ahead of the meter. LED power available indicators shall be supplied on all legs.
4. Circuit Breakers:
 - a. Main Breakers: The panel shall have an inter-lock system between the normal power main breaker and the emergency breaker to ensure only one (1) breaker is in the "on" position at a time. Both breakers shall be equal in size.
 - b. Circuit Breakers: All circuit breakers shall be heavy-duty molded case breakers. The handle on the circuit breakers shall be operational through the inner door.
5. Motor Circuit Protectors: Each pump shall be protected by a 3-pole motor circuit protector. The motor circuit protector shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free from the handle so that the contacts cannot be held closed against a short circuit and abnormal currents which cause the motor circuit breaker to trip. Tripping shall be clearly indicated by the handle automatically assuming a position midway between the normal "on" and "off" positions. All latch surfaces shall be ground and polished. All poles shall be so constructed so that they open, close and trip simultaneously. Motor circuit protector must be completely enclosed in a high-strength glass polyester molded case. Ampere ratings shall be clearly visible. Contacts shall be of non-welding silver alloy. Arc extinction must be accomplished by means of arc chutes. A manual push-to-trip button shall be provided for manual exercising of the trip mechanism. Each pole of these motor circuit

protectors shall provide instantaneous short circuit protection by means of an adjustable magnetic-only element.

6. Motor Starter and Selector Switches: The panel shall contain two (2) motor starters. The motor starter shall be an across the line magnetic starter with individual overload protection on each lower leg with reset installed through the inner door unit. Selector switches shall be installed on the face of the inner door unit. Selector switch shall be a heavy-duty oil tight "Hand-Off-Automatic" three (3)-position switch to control the operation mode of each pump motor starter.
7. Pump Alternator: An eight-pin plug-in solid-state alternator shall be provided to change the pump starting sequence on each pumping cycle. A three (3)-position alternator test switch shall be provided to control the alternation operation. Switch positions, to include the "Auto" to provide normal automatic sequence, "Off" position to disable alternator, and "Test" position with a spring return to allow the alternating of the pump sequence to check alternator operation.
8. Lights and Alarms:
 - a. Indicator Lights: There shall be installed on the face of the inner door unit, heavy-duty oil tight indicator lights as shown on the Standard Drawings.
 - b. High Level Alarm: A vapor proof red light and horn shall be mounted on the top of the panel for high level alarm. In addition, there shall be an alarm silence push-button on the inner door and a silence relay, which will silence the horn and automatically reset when these signals are restored to normal. The push-button shall be heavy-duty oil tight. The red globe shall be the screw-on type.
9. Emergency Power Receptacle: The control panel shall have an external mounted generator receptacle of the required size and type as indicated in Appendix A.
10. Additional Requirements:
 - a. All power wires shall be THW or THWN 75-degree Celsius insulated stranded copper conductors and shall be appropriately sized for the given load application. All control circuit wire shall be type THW, Size 14, stranded wire type. All wiring within the enclosure shall be neatly routed by the use of slotted wiring duct with snap on type covers. Wiring on the rear of the inner door shall be neatly bundled with nylon ties and include sufficient loop across the hinges to prevent wire damage, with each end of the conductor marked as indicated below:
 - i. 24 volt: RED

- ii. Neutral: WHITE
 - iii. 120 volt: BLACK
- b. Terminal points of all terminal strips shall be permanently identified. All terminal numbers and identifying nomenclature shall correspond to and be shown on the electrical diagrams. All wiring shall be permanently shown on the electrical drawings.
- c. All circuit breakers, control switches, indicator pilot lights and other control devices shall be identified with permanently affixed legend plates and lamicoid-type engraved nameplates.
- d. A surge protector shall be included and wired to protect motors and control equipment from lightning induced line surges. All surge protectors shall be United Laboratories (UL) approved and installed per the respective power company requirements and manufacturer's specifications. Surge protectors shall be attached to the main disconnects.
- e. Elapsed time meters shall be 115 volt not-reset type and shall totalize pump-running time in hours and tenths of hours to 99999.9 hours.
- f. On the face of the inner door unit, there shall be installed a 15-amp, 120 volt, duplex convenience receptacle. It shall be provided with its own single pole, 15-amp circuit breaker for protection. Ground fault interrupt type shall be required.
- g. Control terminal blocks shall be of the clamp screw type, rated for 600 volts. Amperage rating shall accommodate the control circuit amperage. An additional 30 space terminal strip shall be installed in the cabinet for future use, with RTU equipment.
- h. There shall be a control power transformer with a minimum size of 500VA to provide 120VA power for: coils for starters, 15A duplex receptacle, indicator pilot lights, alarm horn, pump alternator, elapsed time meters, etc. The secondary side shall have one (1) leg fused and the other grounded. The float switches require this control power transformer and relays shall be 24VAC. A 24 VAC control power transformer properly sized with a fused secondary shall provide this.
- i. All lift stations and pump stations shall include a SCADA system by Data Flow System (DFS) and per NPU's approval.

2.5 MISCELLANEOUS

A. Nameplates

1. Nameplates shall be engraved, laminated plastic, not less than 1/16-in thick by 3/4-in by 2-1/2-in with 3/16-in high black letters on a white background.

PART 3 – EXECUTION

3.1 SLEEVES AND FORMS FOR OPENINGS

- A. Provide and place all sleeves for conduits penetrating concrete slabs. Locate all necessary slots for electrical work and form before concrete is poured.
- B. Exact locations are required for stubbing-up and terminating concealed conduit. Obtain shop drawings and templates from equipment vendors or other subcontractors and locate the concealed conduit before the slab is poured.
- C. Seal all openings, sleeves, penetration and slots.

3.2 CUTTING AND PATCHING

- A. Cutting and patching shall be done in a thoroughly workmanlike manner. Sawcut concrete and masonry prior to breaking out sections.
- B. Core drill holes in existing concrete floors and walls as required.
- C. Install work at such time as to require the minimum amount of cutting and patching.
- D. Do not cut joists, beams, girders, columns or any other structural members.
- E. Cut opening only large enough to allow easy installation of the conduit.
- F. Patching to be of the same kind and quality of material as was removed.
- G. The completed patching work shall restore the surface to its original appearance or better.
- H. Patching of waterproofed surfaces shall render the area of the patching completely waterproofed.
- I. Remove rubble and excess patching materials from the premises.
- J. When existing conduits are cut at the floor line or wall line, they shall be filled with grout of suitable patching material.

3.3 GENERAL INSTALLATION

- A. All work shall be done in a neat and workmanlike manner and in accordance with the National Electrical Code and these specifications. Any work not installed according to the 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 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, and at no additional cost to the 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 at no additional cost to the Owner.
- E. Identify equipment with nameplates as shown on the drawings. Bond nameplate to enclosure using epoxy or similar permanent waterproof adhesive. Double sided foam tape is not acceptable.
- F. Coordinate the conduit installation with other trades and the actual supplied equipment.
- G. Exact locations of electrical equipment 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.
- H. Remove all rubbish and debris from inside and around the equipment. Remove dirt, dust or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner or clean lint-free rags. Do not use compressed air.
- I. Field installed interior wiring shall be neatly grouped by circuit and bound by plastic tie wraps. Circuit groups shall be supported so that circuit

terminations are not stressed.

- J. Install the equipment in accordance with the manufacturer instructions.
- K. Remove temporary lifting angles, lugs and shipping braces. Touch up damaged paint finishes.
- L. Make wiring interconnections between shipping splits.
- M. No operator devices shall be located over 6 ft. 6 in. above the operating floor. Circuit breaker operating handles located more than 6 ft. 6 in. above the operating floor shall have operating arm extensions.

3.4 RACEWAYS, BOXES, FITTINGS AND SUPPORTS

- A. No wire shall be pulled until the conduit system is complete in all details.
- B. The ends of all conduits shall be tightly plugged to exclude dust and moisture during construction.
- C. Conduit supports, other than for underground raceways, shall be spaced at intervals of 8 ft or less, as required to obtain rigid construction.
- D. Single conduits shall be supported by means of aluminum one hole pipe clamps in combination with aluminum one screw back plates, to raise conduits from the surface. Multiple runs of conduits shall be supported on trapeze type hangers with steel horizontal members and threaded hanger rods. The rods shall be not less than 3/8 in diameter. Surface mounted panel boxes, junction boxes, conduit, etc., shall be supported by spacers to provide a minimum of 1/2 in clearance between wall and equipment.
- E. Conduit hangers shall be attached to structural steel by means of beam or channel clamps. Where attached to concrete surfaces, concrete expansion anchors shall be provided.
- F. All conduits on exposed work, within partitions and above suspended ceilings, shall be run at right angles to and parallel with the surrounding wall and shall conform to the form of the ceiling. No diagonal runs will be allowed. Bends in parallel conduit runs shall be concentric. All conduit shall be run perfectly straight and true.
- G. Conduit terminating in NEMA 4X enclosures shall be terminated with Myers grounding type conduit hubs.
- H. Conduits containing equipment grounding conductors and terminating in sheet steel boxes shall have insulated throat grounding bushings with lay-in type lugs.

- I. Conduits shall be installed using threaded fittings. All threads on aluminum conduit and fittings shall be cleaned and coated with "No-Oxide" compound before installing.
- J. Where conduits pass through openings in walls or floor slabs, the remaining openings shall be sealed against the passage of flame and smoke.
- K. All conduit which may under any circumstance contain liquids such as water, condensation, liquid chemicals, etc., shall be arranged to drain away from the equipment served. If conduit drainage is not possible, conduit seals shall be used to plug the conduits.
- L. Conduits passing from heated to unheated spaces, exterior spaces, refrigerated spaces, cold air plenums, etc., shall be sealed with "Duxseal" as manufactured by Manville or seal fitting to prevent the accumulation of condensation. Seal the ends of raceways and make watertight at all handholes, buildings and structures.
- M. Swab all raceways clean before installing cable.
- N. Existing conduits are to be reused only where specifically noted on the drawings. Mandrels shall be pulled through all existing conduits which will be reused and through all new conduits 2 in in diameter and larger prior to installing conductors.
- O. The use of running threads is prohibited. Where such threads are necessary, a 3 piece cast aluminum union shall be used.
- P. Spare conduits and conduit stub-outs for future construction shall be provided with a pull string (securely fastened and provided with identification tag) and threaded PVC end caps at each end.
- Q. All conduits shall have a 4-inch concrete housekeeping pad at all slab and grade penetrations. The housekeeping pad shall have 45-degree, 3/4-inch chamfer at all exposed edges.
- R. Where no size is indicated for junction boxes, pull boxes or terminal cabinets, they shall be sized in accordance with the requirements of NEC Article 314.
- S. All underground control and instrumentation conduits shall be separated from power conduits by a minimum of 12 inches unless specifically noted otherwise. Crossing of control and instrumentation conduits with power conduits shall be kept to a minimum and where they must cross they shall cross at 90-degree angles.

3.5 WIRES, CABLES, AND ACCESSORIES

- A. Use lubrications to facilitate wire pulling. Lubricants shall be UL approved for use with the insulation specified.
- B. Identify wires as with color code at each junction box or termination point as described herein. Color code shall be as follows for the 480Y/277VAC system: phase A (brown), phase B (orange), phase C (yellow), neutral (gray), ground (green).
- C. Power conductors: Terminations shall be die type or set screw type pressure connectors as specified. Splices (where allowed) shall be die type compression connector and waterproof with heat shrink boot or epoxy filling.
- D. Unless specifically permitted by the Engineer, no splices between termination points will be allowed.
- E. All raceways shall include an equipment grounding conductor.
- F. Seal openings in slabs and walls through which wires and cables pass.
- G. Steel fish tapes and/or steel pulling cables shall not be used in PVC conduit runs.
- H. Pull cables from the direction that requires the least tension. Use a feed-in tube and sheave designed for cable installation. Use sheaves with radii that exceed the cable manufacturer's recommended minimum bending radius. Use a dynamometer and constant velocity power puller. Velocity should not be less than 15-ft./min. or more than 50-ft./min. Do not exceed the cable manufacturer's maximum recommended tension.
- I. If cable cannot be terminated immediately after installation, install heat shrinkable end caps.

3.6 GROUNDING

- A. Grounding shall be in accordance with NEC Article 250.

3.7 TESTS AND SETTINGS

- A. Test systems and equipment furnished under Division 16 and repair or replace all defective work and equipment.
- B. Verify all terminations at transformers, equipment, panels and enclosures are connected to the proper terminals by producing a 1, 2, 3

rotation on a phase sequenced motor when connected to "A," "B" and "C" phases.

- C. Verify correct wire termination positions across tie circuits, transfer switches, or other devices that normally have two sources of three-phase power present by performing a hot phase test. That is, in addition to verifying clock-wise rotation, a voltage reading across both incoming circuits should nominally measure zero (0) volts when phase "A" of one source is compared to phase "A" of the other source.
- D. Check all wire and cable terminations for correct torque requirements.
- E. Make adjustments to the systems and instruct the Owner's personnel in the proper operation of the systems.
- F. 600 Volt Wire
 - 1. Test all 600-volt wire insulation with a megohm meter after installation and prior to termination. Make tests at not less than 1,000 volts DC. Submit a written test report of the results to the Engineer. Notify Engineer in writing 48 hours prior to testing.
 - 2. Field testing and commissioning shall be done in accordance with the latest revision of the "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems" published by the InterNational Electrical Testing Association (NETA Standard ATS) unless otherwise modified by this Section. Minimum wire insulation resistance shall not be less than 250 Megohms.
 - 3. Submit a written test report of the results to the Engineer.

END OF SECTION