July 10, 2015

ADDENDUM NO. 3
To the Contract Documents for the
Five Mile Creek WWTP Influent Pump Control Modifications

TO: PLAN HOLDERS
PROSPECTIVE BIDDERS

The following changes, additions, and/or deletions are hereby made a part of the contract documents for the **Five Mile Creek WWTP Influent Pump Control Modifications** fully and completely as if the same were fully set forth therein:

A. **Electrical Specifications**

Delete –
Electrical Specifications dated February 11, 2015
Replace with –
Electrical Specifications dated March 13, 2015 attached to this Addendum No. 3

B. **Plans**

Delete –
Plans dated February 11, 2015
Replace with –
Plans dated March 13, 2015 attached to this Addendum No. 3

JRA PROJECT NO. 214114
INFLUENT PUMP CONTROL MODIFICATIONS
FIVE MILE WWTP
JEFFERSON COUNTY ENVIRONMENTAL SERVICES DEPARTMENT
JEFFERSON COUNTY, ALABAMA
CLIENT JOB NO. 1
BASED ON CLIENT TEMPLATE: "JRA.dot"
PRINTED ON: March 13, 2015

ELECTRICAL SPECIFICATION INDEX:

DIVISION 26/27/28
ELECTRICAL

3/13/2015

SECTION 26 05 00 – BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 DESCRIPTION

A. General Conditions:
   1. The accompanying General Conditions (front-end specifications) shall apply to and form a part of this section.

B. General Requirements:
   1. Carefully examine General Conditions, other specification sections, and other drawings (in addition to Electrical) in order to be fully acquainted with their effect on electrical work.
   2. Do all work in compliance with all applicable codes, laws, and ordinances, the National Electrical Safety Code, the National Electrical Code (hereinafter referred to as "Code"), applicable energy codes, and the regulations of the local utility companies. Obtain and pay for any and all required permits, inspections, certificates of inspections and approval, and the like.
   3. Cooperate with other trades and contractors at job. Perform work in such manner and at such times as not to delay work of other trades. Complete all work as soon as the structure and installations of equipment will permit. Patch, in a satisfactory manner and by the proper craft, any work damaged by electrical workmen.
   4. The Owner shall be provided access to all software to include copies of software for all systems provided under this division of the specifications. Software shall be password protected where applicable.
   5. Only qualified electrical sub-contractors will be allowed to submit proposals for this project. In order to be considered qualified, contractor shall have completed a minimum of five (5) projects of similar type/scope and equal or greater magnitude and complexity within the last ten (10) years. Sub-contractors without qualifications will be rejected. If desired, potential electrical sub-contractors may submit qualification evidence for review and pre-bid approval a minimum of ten (10) days prior to bid. Previous projects used to meet this experience requirement must have included similar (or greater) scopes of work for each of the following areas:
      a. Power Systems.
      b. Control Systems.
      c. Instrumentation Systems.
   6. Electrical contracting firm shall be licensed as an electrical contractor in the state where work will be performed

1.2 GENERAL SCOPE OF ELECTRICAL WORK (REFER TO DRAWINGS FOR OTHER SPECIFIC SCOPE ITEMS)

A. Furnish all labor and materials to complete electrical work as shown on drawings and/or herein specified.

B. Remove all existing electrical equipment and wiring made obsolete by this project and remove or relocate all electrical services located on or crossing through the project property, either above or below grade, which would obstruct the construction of the project or conflict in any manner with the completed project or any code pertaining thereto. Dispose of salvageable materials as directed by the Engineer. Contractor shall schedule meeting to review scope of electrical demolition and to confirm scope and phasing of proposed demolition with the owner in the presence of the prime consultant prior to start of any electrical demolition.

C. Furnish and install complete power distribution system as shown on drawings and/or specified herein.

D. Furnish and install complete variable frequency drive modifications as shown on drawings and/or specified herein.

E. Furnish and install complete electrical grounding systems as shown on drawings and/or specified herein.

F. Install and connect electrical equipment mentioned in Division 26/27/28 Specifications or noted in drawings, whether furnished by electrical contractor or by others.
   1. Where shown or specified, equipment furnished by others shall be installed and connected under this Contract.
   2. Where shown or specified, Contractor shall receive, unpack, check and assume custody of equipment furnished by Others. Contractor shall assume responsibility for care and safekeeping of this equipment, when delivered into his custody. He shall protect it from moisture, dust and damage during construction and until Owner acceptance of project.

G. Furnish and install all electrical items shown on drawings and/or herein specified, unless shown or specified otherwise.

H. Furnish and install complete controls, instrumentation & auxiliary systems as shown on drawings and/or specified herein.

I. Procure and pay for permits and certificates as required by local and state ordinances and fire underwriter's certificate of inspection.

J. Balance loads as equally as practicable on services, distribution feeders, circuits and buses. Provide typewritten directory for each panel.

K. Complete field testing, adjustment & startup of all systems listed above as shown on drawings and/or specified herein.

PART 2 - PRODUCTS

2.1 APPROVED MATERIALS AND DEVICES

A. Where not otherwise specified, provide only new, standard, first-grade materials throughout, conforming to standards established by Underwriter's Laboratories, Inc., and so marked or labeled, together with manufacturer's brand or trademark. All equipment subject to approval of Engineer before installation. All like items and associated equipment shall be of one manufacturer.

B. To insure proper coordination, it is intended that all electrical equipment and materials specified in Division 26/27/28 of these specifications and shown on the electrical drawings be furnished and installed by the electrical sub-contractor. It will not be permissible for any of these items to be furnished directly by the general contractor without the electrical contractor's coordination.

C. To insure commonality of spare parts, it is required that the electrical contractor provide the same brand for all circuit breakers, starters, power equipment, etc. provided under the following divisions of these specifications:

2.2 SUBMITTALS

A. All submittals to the design team shall be accompanied by a letter summarizing all proposed deviations from specified products or pre-approved substitutions. The absence of such a letter shall be understood to indicate that the contractor intends to meet all contract requirements, regardless of cut-sheets/data-sheets provided within the submittal.

B. Submit to Engineer ten (10) days prior to bid date three (3) copies of any items and/or manufacturers which are proposed as substitutes for those specified.

C. Submit to Engineer promptly after award of Contract and prior to purchasing, the number of copies required by the contract. All drawings of a specific item or system shall be made in one submittal, and within thirty (30) days after award of Contract. Shop drawings of all power equipment shall contain exact details of device placement, phasing and numbering, in form of elevations, for each major piece of equipment. Shop drawings shall be submitted on the following:

1. SECTION 26 29 00: MANUFACTURED CONTROL PANELS
2. SECTION 26 29 23: VARIABLE FREQUENCY DRIVES
3. SECTION 27 60 00: SCADA SYSTEM
4. ALL MISCELLANEOUS POWER DISTRIBUTION EQUIPMENT
5. ALL ELECTRICAL AND TELECOMMUNICATION ROOM LAYOUTS - Submittals shall include ¼" = 1'-0" CAD drawings (hand drawn sketches will not be accepted) of each electrical and IT room indicating all panelboards, transformers, switchboards, equipment racks, control panels, HVAC equipment, etc. that are located in each room. Layouts shall show that each piece of electrical equipment has the clearances, working space and dedicated equipment space required by applicable codes. No conduits to equipment within these rooms shall be installed until submittals have been provided and returned without exception by the design team.
6. ALL CONTROL ITEMS & SYSTEMS

D. The contractor shall fully review, comment upon and correct all shop drawings as required to assure compliance with contract documents prior to submittal to Engineer. The failure of the contractor to properly review and correct shop drawings prior to submittal will result in rejection of shop drawings by the engineer. Review by the Engineer will be for general conformance with contract documents. The contractor shall be fully responsible for correctness of all submitted dimensions, details, quantities and locations.

E. None of the above items shall be installed until shop drawings or catalog data have been reviewed by Engineer without rejection or required resubmittal. Any listed item not submitted, even if specified, shall be considered not acceptable and shall be removed if directed.

F. Any required resubmittal will be reviewed by the Engineer for conformance with previously issued comments only. The contractor shall be responsible for verifying that all items not specifically requiring resubmittal have not been altered from the previously reviewed submittal.

G. Material proposed for substitution shall be of the same quality, perform the same functions, conform to such physical dimensions and appearance as are required by the Engineer. All material proposed for substitution is subject to the approval of the Engineer and his authority for approval is final. No material proposed for substitution will be considered unless all submittal data complies with the drawings and specifications of Section 16 as to time of submission, number of copies of submittal, and detail requirements.

H. Samples of material shall be furnished where required by drawings or Division 26/27/28 Specification, or as requested by the Engineer on items proposed as substitutes.

I. Submit to Engineer a certificate of final inspection from local inspection department.

PART 3 - EXECUTION

3.1 SITE VISIT

A. The Contractor shall visit the site to determine existing dimensions and conditions affecting electrical work. Failure to do so in no way relieves Contractor of his responsibility under Contract.

3.2 WORKMANSHIP

A. All work shall be in accordance with the latest editions of NFPA 70 (National Electrical Code), NFPA 101 (Life Safety Code), National Electric Safety Code, International Building Code, applicable NECA standards and the rules and regulations of State and Local Authorities Having Jurisdiction.

B. All work shall be executed in a workmanlike manner and shall present a neat and mechanical appearance upon completion.

C. All equipment, devices, etc. shall be installed in accordance with manufacturer's recommendations.

D. All items shall be installed straight and plumb in a workmanlike manner and care shall be exercised so that like items are mounted the same position, heights and general location.

E. Keep site clean of accumulation of cartons, trash and debris.

3.3 SAFETY

A. The contractor is solely responsible for all job safety. Engineer assumes no responsibility for job safety. Maximum consideration shall be given to job safety and only such methods as will reasonably insure the safety of all persons shall be employed. The codes and regulations of OSHA shall be given strict compliance as well as such other codes, laws, and regulations as may be applicable.

3.4 CONTRACT DOCUMENTS

A. Contract documents indicate diagrammatically, extent, general character and approximate location of work. Where work is indicated but minor details omitted, furnish and install it complete so as to perform its intended functions. For details and mechanical equipment, follow drawings provided by other disciplines (Architectural, Mechanical, Structural, Civil, etc.) and fit electrical work thereto.

B. Contract documents consist only of the hardcopy documents issued by the Prime Engineer. Electronic documents issued directly by the electrical engineer to the contractor and/or its sub-contractors/vendors are issued for convenience only (electronic documents are not formal contract documents).

C. If the contractor and/or one of its suppliers require a one-time transfer of electronic files of the current electrical construction documents to prepare shop drawings (or for another similar purpose), it shall:
   1. Sign a waiver prepared by the electrical engineer prior to the transmittal of these files.
   2. Agree to pay the electrical engineer a fee of $50.00 per drawing, up to a maximum of $400 per transfer, payable upon receipt of the files.
   3. To the fullest extent permitted by law, indemnify, hold harmless, and defend JRA from all claims, damages, losses and expenses, including attorneys' fees arising out of or resulting from the use of the CAD files.

D. Take finish dimensions at job in preference to scaled dimensions.

E. Except as above noted, make no changes in or deviations from work as shown or specified except on written order of Engineer.

3.5 UNDERGROUND UTILITY/EQUIPMENT COORDINATION

A. Prior to commencement of work, verify exact locations of all existing or proposed underground utilities and/or underground equipment and verify that proposed electrical

installation does not conflict with these items. Notify Engineer immediately if any conflict is found.

3.6 EQUIPMENT STORAGE

A. Store all electrical equipment in dry, covered locations as directed by equipment manufacturers. Contractor shall be responsible for replacing or repairing improperly-storted equipment as directed by Engineer.

3.7 EXCAVATION, CUTTING AND PATCHING

A. Perform all cutting and excavating as necessary for installation of electrical systems, unless specifically covered under another section. After Engineer's observation, complete all excavation, filling and backfilling as directed under specifications for preparation of site and earthwork. Foundations for equipment shall be as specified under concrete section. Concrete pads shall be minimum of 6" thick; unless greater thickness required by equipment manufacturer. Obtain specific approval of Engineer before cutting into any structural members.

B. For all such work employ competent workmen, and finish up in neat and workmanlike manner, equal to quality and appearance to adjacent work.

3.8 ROOF PENETRATION

A. Furnish roof flashing for all equipment installed under Division 26/27/28 that penetrates through the roof. Appropriate flashing is specified under roofing and sheet metal section. Supply these flashings for installation under roofing and sheet metal section.

3.9 INSTALLATION OF EQUIPMENT - GENERAL

A. Care shall be exercised in exact routing and location of all items so as not to obstruct access to equipment, personnel walkways, or expose it to potential mechanical damage.

B. Items shall be securely anchored and/or fastened. All construction shall meet the seismic design requirements of the building code. Items (especially transformers, light fixtures, equipment racks, freestanding gear, etc.) installed in seismic zones C, D, E or F shall be supported and braced per applicable codes and standards.

C. All wall, pole or frame-mounted electrical equipment shall be mounted to metal unistrut (or similar) frames of same material as electrical equipment. For example, pole-mounted stainless steel disconnect switches shall be mounted to stainless steel unistrut frames.

D. All electrical equipment, furnished by Contractor or by others shall be covered and protected during construction.

E. All control cabinets, panels, motor control centers and other electrical cabinets and enclosures shall have all trash removed and be vacuumed clean. All foreign paint, etc., shall be removed from exterior and all scratches in finish touched up with same color and material

as original. Any rusted areas shall be sanded, primed and repainted.

F. All relays, starters, push-button and other control devices shall be cleaned and if necessary, lubricated with CRC 2-26 to assure free operation.

3.10 MOTORS, STARTERS AND CONTROLS

A. Unless otherwise specified or shown, all motors will be furnished and installed under other sections of this specification.

B. Electrical Contractor shall install all starters and all electrical power wiring and connections to motors and starters.

C. Unless otherwise specified or shown, all control items for motors shall be furnished, installed and wired in conduit by the electrician.

3.11 CIRCUITS AND BRANCH CIRCUITS

A. Outlets shall be connected to branch circuits as indicated on drawings by circuit numbers. No more outlets than are indicated shall be connected to a circuit.

B. Branch circuit homeruns shall be installed as shown on drawings. Multiple homerun conduits shall not be combined by contractor into larger, single homerun conduits unless specific permission is granted by the Engineer.

3.12 LUG/TERMINAL RATINGS

A. All lug/terminal ratings, sizes, locations, types, etc. shall be coordinated with the associated conductor sizes, types, routings, etc. by the contractor.

3.13 OUTLET LOCATION

A. Symbols shown on drawings and mounting heights indicated on drawings and in specifications are approximate only. The exact locations and mounting height must be determined on the job and it shall be the Contractor's responsibility to coordinate with other trades to insure correct installation.

3.14 IDENTIFICATION

A. Each panel shall have each circuit identified. Panels without branch circuit nameplates shall have typewritten directories.

B. Each individually mounted switch, circuit breaker, starter and/or any other control or protective device shall identify equipment fed and fuse size, if any, by engraved plastic nameplate, white with black letters, screw attached.

C. See Specification Section 26 05 53 for additional requirements.

3.15 GROUNDING

A. All equipment shall be grounded and bonded in accordance with all state/local regulations, The National Electrical Code and as specified herein.

3.16 PAINTING

A. Refer to Painting/Finishing specifications for requirements regarding field painting of exposed conduit. Any scratches, dents or rust spots in conduit electrical enclosures, panels, motor control or any other electrical items shall have the dents removed, and they, along with any rust spots or scratches, sanded and touched up with the same exact color paint as original finish.

3.17 ACCEPTANCE TESTING

A. Upon completion of work, the entire electrical system installed within this project shall be tested and shall be shown to be in perfect working condition, in accordance with the intent of the specifications and drawings. It shall be the responsibility of the Electrical Contractor to have all systems ready for operation and to have an electrician available to operate same in accordance with and under the supervision of the observation representative(s) of the Engineer. The Electrician shall be available to assist in removal of panel fronts, etc., to permit inspection as required.

B. The electrical sub-contractor shall include in bid price start-up assistance and training from a certified representative of the manufacturer for the following systems:
   1. SECTION 26 29 23: VARIABLE FREQUENCY DRIVES
   2. SECTION 27 60 00: SCADA SYSTEM

3.18 OPERATION AND MAINTENANCE DATA

A. One set of marked “AS BUILT” drawings, three (3) sets of all equipment catalog and maintenance data and three (3) sets of all final shop drawings, on all equipment requiring same shall be turned over to owner. These items shall be bound in hard back book. Contractor shall explain and demonstrate all systems to Owner’s representative.

3.19 GUARANTY-WARRANTY

A. Furnish a written Guarantee-Warranty, countersigned and guaranteed by General Contractor, stating:
   1. That all work executed under this section will be free from defects of workmanship and materials for a period of one (1) year from date of final acceptance of this work.
   2. Above parties further agree that they will, at their own expense, repair and replace all such defective work, and all other work damaged thereby, which becomes defective during the term of the Guaranty-Warranty.

END OF SECTION 26 05 00

SECTION 26 05 19 – POWER CONDUCTORS AND CABLES 51V-600V

PART 1 - GENERAL

1.1 DESCRIPTION

A. Power Wires and Cables

B. Low Voltage Wires and Cables

PART 2 - PRODUCTS

2.1 POWER WIRES AND CABLES - 600 VOLT

A. General: Conductors shall have current carrying capacities as per N.E.C. and with 600 volt insulation, #12 minimum except for controls and fixture wire. Conductors shall be copper.

B. General Application (see below for exceptions):
   1. At or Below Grade (including within slab-on-grade):
      a. #8 or larger conductors:
         1) XHHW or RHH/RHW/USE stranded (in conduit).
      b. #10 or smaller conductors for circuits terminating at motors:
         1) THHN/THWN or XHHW stranded (in conduit).
      c. #10 or smaller conductors (excluding circuits terminating at motors):
         1) THHN/THWN or XHHW solid (in conduit).
   2. Above Grade:
      a. #8 or larger conductors:
         1) THHN/THWN, XHHW or RHH/RHW/USE stranded (in conduit).
      b. #10 or smaller conductors for circuits terminating at motors:
         1) THHN/THWN, XHHW or RHH/RHW/USE stranded (in conduit).
      c. #10 or smaller conductors (excluding circuits terminating at motors):
         1) THHN/THWN, XHHW or RHH/RHW/USE solid (in conduit).
   3. Power Wire and cable shall be as manufactured by Southwire, Rome, American Insulated Wire, Okonite, Phelps-Dodge, Amercable, Aetna or approved equal.

C. VFD Cabling
   1. Wiring/Cabling installed between each VFD (Variable Frequency Drive) and the associated motor shall be multi-conductor shielded VFD power cable with the following characteristics:
      a. Multi-conductor cable with three (3) power conductors and three (3) ground conductors
      b. Soft annealed flexible stranded copper conductors.
      c. 1kV cross-linked polyolefin insulation (to resist the potential reflected voltages experienced in 600VAC VFD applications).
      d. Metallic shielded providing 100% shield coverage

e. Oil, abrasion, chemical & sunlight resistant thermosetting compound outer jacket.
f. Flexible TC-ER rated, UL listed for use in cable trays.
g. Equal to AmerCable #37-108VFD cable.

D. Emergency Feeder Wiring
1. All feeder-circuit wiring for emergency systems (as defined by NEC article 700) and legally-required standby systems (as defined by NEC article 701) shall be a listed electrical circuit protective system consisting of 2-hour fire-rated, mineral insulated, copper-sheathed wiring cable (Pyrotenax System 1850 or equal).

E. Class 1 Control Cabling (120VAC Control Circuits, Etc.)
1. Unless specified otherwise, Class 1 control cabling shall:
a. Be rated for exposed cable tray installation.
b. Be plenum rated (Class 1 Control cabling and Instrumentation cabling installed in conduit or exposed in cable tray in non-plenum areas is not required to be plenum-rated).
c. Be UL-rated for the proposed application.
d. Be multi-conductor with overall outer sheath as required by the application. The insulation of each conductor within the overall multi-conductor cable shall be uniquely color-coded. Ground conductors (when provided) within the multi-conductor cable shall have green insulation.
e. Utilize copper conductors.
f. Have wire gauge as required to limit voltage drop to acceptable limits determined by the system supplier and to meet all applicable code requirements.
g. Where installed underground, within slab-on-grade or in exterior locations, be rated for wet locations.
h. Where required for specific systems, meet the specific requirements (conductor quantity, wire gauge, insulation type, shielding, etc.) of the system supplier.
i. Be rated for 600V.
j. Be industrial grade.
k. Have stranded conductors.
l. Have sunlight/oil-resistant PVC/Nylon insulation and jacket with ripcord.
2. Control cabling shall be as manufactured by Belden, AlphaWire or General Cable.

F. Fixture Wiring
1. Conductor Types:
a. Type TFFN or XFF.
2. Minimum Sizes:
a. For fixtures up to 300 watts: #16.
b. For fixtures over 300 watts up to 1500 watts: #14.
c. For fixtures over 1500 watts: as required.
d. Conductors to concrete pour fixtures: #12.
3. Fixture wire shall extend only from fixture to first junction, and not over 6 feet, except for concrete pour units.

2.2 COPPER WIRE CONNECTIONS:

A. At Motor Connections (within motor terminal boxes):
   1. On Unshielded Wire:
      a. Single conductor per phase: shall be made with insulated set screw connectors or 3M 5300 Series 1kV Motor Lead Connections kits with mechanical lugs as required.
      b. Multiple conductors per phase: shall be made with insulated mechanical lugs, rated for the associated motor cable types, by Polaris or Ilsco.
   2. On Shielded Power Wire:
      a. The braided shields and internal grounding conductors of shielded power (not instrumentation) cables shall be grounded at BOTH ends (at VFD/starter and at motor) with a termination kit provided by the cable supplier. This termination kit shall include a connection ring that makes contact around the full circumference of the braided shield, and connects all internal grounds to a common external ground point.

B. Other Dry locations:
   1. On Wire larger than #10: shall be made with solderless, non-insulated compression-type connectors meeting requirements of Federal Specification WS-610e for Type II, Class 2 and shall be covered with Scotch #33 electrical tape so that insulation is equal to 150% of conductor insulation.
   2. On Wire #10 and smaller: shall be made with one of the following:
      a. Ideal Wing Nuts or equal by 3M .
      b. Ideal Push-In Wire Connectors (for #12 and smaller only).

C. Other Wet/Damp locations:
   1. On Wire larger than #10: shall be made with solderless, non-insulated compression-type connectors meeting requirements of Federal Specification WS-610e for Type II, Class 2 and shall be covered with Scotch #33 electrical tape so that insulation is equal to 150% of conductor insulation.
   2. On Wire #10 and smaller: shall be made with one of the following:
      a. Ideal Weatherproof or Underground Wire Connectors pre-filled with 100% silicone sealant as required by the application.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. All wires and cables shall be installed in conduit unless specifically noted otherwise.

B. All joints and splices on wire shall be made with solderless connectors, and covered so that insulation is equal to conductor insulation.

C. No splices shall be pulled into conduit.

D. No conductor shall be pulled until conduit is cleaned of all foreign matter.

E. Wire and cable shall be neatly formed, bundled and tied in all panelboards, wireways,

disconnect switches, pullboxes, junction boxes, cabinets and other similar electrical enclosures.

F. All wires and cables installed in underground or other wet locations shall be rated by the manufacturer for wet locations.

G. Network cabling shall be continuous from endpoint to endpoint and shall not be spliced unless specifically noted otherwise.

3.2 POWER WIRE AND CABLE INSTALLATION:

A. No power conductor shall be smaller than #12 except where so designated on the drawings or hereinafter specified.

B. Multi-wire lighting branches shall be used as indicated.

C. Where more than three current-carrying conductors are installed in a single raceway or cable, conductors shall be derated as indicated in NEC Table 310.15(B)(3)(a).

D. Raceways/cables shall generally not be installed exposed to sunlight on roofs unless specifically required. Where raceways or cables are installed exposed to sunlight on roofs, conductors shall be derated with ampacities adjusted per NEC Table 310.15(B)(3)(c).

E. In installing parallel power conductors, it is mandatory that all conductors making up the feeder be exactly the same length, the same size, the same type of conductor with the same insulation. Each group of conductors making up a phase or neutral must be bonded at both ends in an approved manner.

F. In installing overhead main power services, a minimum of 5’-0” of cable per run shall be extended beyond the weatherhead(s) for connection to service drop. Confirm exact requirements with local utility company.

3.3 WIRE CONNECTIONS

A. See Part 2 above for material types.

B. Aluminum Wire Connections:
   1. Where aluminum wiring is allowed, connections shall utilize compression fittings, no exceptions (Anderson Versa Crimp or equal).

C. Any stranded wire connection to wiring devices shall be made with crimp type terminals.

D. All electrical connections and terminals shall be tightened according to manufacturer’s published torque-tightening values with calibrated torque wrenches as required to clearly indicate final torque value to the contractor. Where manufacturer’s torque values are not provided, those specified in UL 486A & 486B shall be used.

E. All connections and connector types shall be installed in strict compliance with all

requirements of the connector manufacturer.

3.4 SHIELDED CABLE INSTALLATION

A. Shielded VFD (power) cables:
   1. The braided shields and internal grounding conductors of shielded VFD (power) cables shall be grounded at BOTH ends (at VFD and at motor) with a termination kit provided by the cable supplier. This termination kit shall include a connection ring that makes contact around the full circumference of the braided shield, and connects all internal grounds to a common external ground point.
   2. Contractor shall coordinate the necessary size of conduit with the outer diameter of the proposed cable type to verify that the raceway loading does not exceed NEC requirements prior to rough-in of the conduit system.

B. Shielded instrumentation (low voltage) cables:
   1. The outer foil of shielded instrumentation cables shall be grounded at the PLC/control panel end only (not at the field device end) with a termination kit as directed by the PLC/control panel supplier.

3.5 LOW VOLTAGE (LESS THAN 50V) CONTROL AND NETWORK CABLE INSTALLATION:

A. All wires and cables shall be installed in conduit unless specifically noted otherwise. Low voltage control and/or network cabling located within concealed, accessible ceiling spaces (such as above lay-in ceilings) may be run without conduit if the following requirements are met:
   1. Cabling shall be plenum-rated, multi-conductor.
   2. Cabling shall be supported by cable tray or with J-hook supports on intervals not to exceed 5’-0” on center. Cabling shall be supported solely from the cable tray or j-hooks supported from the building structure, without using piping, ductwork, conduit or other items as supports.
   3. Cabling shall be properly bundled with plenum-rated Velcro straps on intervals not to exceed 30” on center.
   4. Properly-sized conduit(s) shall be provided wherever cabling enters an inaccessible or exposed area (such as above gyp board ceilings or through walls). End bushings shall be provided on both ends of all raceway terminations. All fire/smoke barrier penetrations shall be made in accordance with a U.L. listed assembly.

3.6 CIRCUITS AND BRANCH CIRCUITS

A. Outlets shall be connected to branch circuits as indicated on drawings by circuit number adjacent to outlet symbols, and no more outlets than are indicated shall be connected to a circuit.

3.7 LABELING AND COLOR CODING OF WIRE AND CABLE

A. Refer to Specification Section 26 05 53 for all labeling requirements.

B. A color coding system as listed below shall be followed throughout the network of branch

power circuits as follows:

PHASE	120/208/240/ COLOR	120/240 HIGH LEG DELTA COLOR	277/480 VOLT COLOR
A	BLACK	BLACK	BROWN
B	RED	ORANGE (FOR HI-LEG)	ORANGE
C	BLUE	BLUE	YELLOW
NEUTRAL	WHITE	WHITE	GRAY
GROUND	GREEN	GREEN	GREEN

C. Where dedicated neutrals are installed for multi-wire branch circuits, the neutral conductors shall be color coded as follows:

PHASE	120/208/240/ COLOR	120/240 HIGH LEG DELTA COLOR	277/480 VOLT COLOR
NEUTRAL A	WHITE W/ BLACK TRACER	WHITE W/ BLACK TRACER	GRAY W/ BROWN TRACER
NEUTRAL B	WHITE W/ RED TRACER	WHITE W/ ORANGE TRACER (FOR HI-LEG NEUTRAL)	GRAY W/ ORANGE TRACER
NEUTRAL C	WHITE W/ BLUE TRACER	WHITE W/ BLUE TRACER	GRAY W/ YELLOW TRACER

D. Control Conductors: Shall be color coded by use of colored “tracers”. No control circuit shall contain two identical conductors. For example, a set of five (5) control conductors for a pushbutton station represents one (1) control circuit which would require five (5) uniquely-colored control conductors.

3.8 TESTING

A. The insulation resistance of all feeder conductors (feeding electrical distribution equipment such as switchboards, panelboards, transfer switches, transformers, etc.) shall be tested at the load side of the feeder breaker with a 500-volt DC Megger Tester. Any feeder conductor with an insulation resistance less than 1 Mega ohm to ground shall be replaced by the contractor at the contractor's expense. All final test results shall be clearly documented (with date, time, feeder, results, test equipment, etc.), and the final test results shall be submitted to the design team for review.

END OF SECTION 26 05 19

SECTION 26 05 33 – RACEWAYS

PART 1 - GENERAL

1.1 DESCRIPTION

A. THE WORK UNDER THIS SECTION INCLUDES BUT IS NOT LIMITED TO THE FOLLOWING:
1. Conduits
2. Conduit Fittings
3. Couplings & Connectors
4. Bushings
5. Raceway Hardware, Conduit Clamps & Supports
6. Watertight Entrance Seal Devices

PART 2 - PRODUCTS

2.1 CONDUITS

A. Rigid Galvanized Steel and I.M.C.:
1. Shall be galvanized outside and inside by hot dipping.
2. Shall be as manufactured by Republic, Wheatland, Triangle, Pittsburg Standard, Youngstown, Allied or equal.

B. E.M.T.:
1. Shall be Electro-Galvanized.
2. Shall be as manufactured by Republic, Wheatland, Triangle, Pittsburg Standard, Youngstown, Allied or equal.

C. Rigid Aluminum:
1. Shall be manufactured of 6063 Alloy, T-1 temper.
2. Shall be as manufactured by Republic, Wheatland, Triangle, Pittsburg Standard, Youngstown, Allied or equal.

D. Schedule 40 and 80 PVC:
1. Shall be composed of polyvinyl chloride and shall be U.L. rated type 40 or 80 for use with 90 degree rated conductors. Conduit shall conform to NEMA Standards and applicable sections of N.E.C.
2. The conduit manufacturer shall have had a minimum of 5 years experience in the manufacture of the products. Non-metallic raceways shall be as manufactured by Carlon, Triangle, Can-Tex, Allied or equal.

E. HDPE Innerduct
1. Shall be composed high density polyethylene and shall be orange in color, unless noted otherwise.
2. Shall be corrugated unless noted otherwise.

3. Shall be manufactured by Carlon, Ipex or equal.

F. Flexible Metallic Conduit:
1. Shall be continuous spiral wound and interlocked galvanized material, code approved for grounding.

G. Liquidtight Flexible Metallic Conduit:
1. Shall be corrosion-resistant aluminum-core sealtite, code approved for grounding.
2. Shall have an outer liquidtight, nonmetallic, sunlight-resistant jacket over an inner flexible metal core.
3. Shall be as manufactured by UA, Electric-Flex, Anaconda or equal.

2.2 FITTINGS, COUPLINGS & CONNECTORS

A. Rigid Galvanized Steel and I.M.C. couplings and connectors shall be standard threaded type, galvanized outside and inside by hot dipping. Threadless and clamp type are not acceptable. Couplings/connectors shall be as manufactured by Raco, Efcor, or Appleton or equal.

B. All fittings, couplings and connectors (including sealtite connectors) used in areas where PVC-Coated Rigid Steel conduit is used shall also be PVC-coated.

C. All rain tight connectors shall be threaded Myers or approved equal, rated for outdoor application.

D. E.M.T. couplings and connectors shall be set screw, or steel compression type. All couplings and connectors shall be 720B, 730, 750B, or 760 series of Efcor or equal series of Raco. Pressure indented type connectors or cast metal will not be approved for any location. E.M.T. couplings and connectors shall be as manufactured by O-Z/Gedney, T&B, Efcor, Raco, Midwest or equal. E.M.T. fittings, couplings and connectors located within concrete (where allowed) shall be compression type and shall be adequately sealed with tape to ensure a concrete-tight seal.

E. Rigid Aluminum couplings and connectors shall be standard threaded type, of the same alloy as the associated conduit. Threadless and clamp type are not acceptable. Fittings shall be as manufactured by Thomas & Betts, Crouse-Hinds, Appleton, Pyle-National or equal.

F. All PVC couplings, adapters, end bells, reducers, etc., shall be of same material as conduit.

G. Liquidtight Flexible Metallic Conduit connectors shall be aluminum liquidtight with insulating throat or end bushing, designed for application with aluminum-core Liquidtight Flexible Metallic Conduit. Fittings shall be as manufactured by Efcor, Raco, Midwest or equal.

H. All LB unilets shall have rollers.

I. Miscellaneous conduit fittings shall be as manufactured by Appleton, Crouse-Hinds, Pyle-National, Russell & Stoll or equal.

2.3 BUSHINGS

A. All non-grounding rigid bushings 1-1/4" and larger shall be the insulating type (O-Z/Gedney type "BB" or equal by T&B, Midwest Electric or Penn Union).

B. All non-grounding rigid bushings 1" and smaller shall be threaded malleable iron with integral noncombustible insulator rated for 150°C. Non-grounding rigid conduit bushings shall be O-Z/Gedney type "B" or equal by T&B, Midwest Electric or Penn Union.

C. All grounding rigid bushings shall be threaded malleable iron with integral noncombustible insulator rated for 150°C. All grounding rigid conduit bushings shall be O-Z/Gedney type "BLG" or equal by T&B, Midwest Electric or Penn Union.

2.4 HARDWARE, CONDUIT CLAMPS AND SUPPORTS

A. All hardware such as expansion shields, machine screws, toggle bolts, "U" or "J" bolts, machine bolts, conduit clamps and supports shall be of corrosion resistant materials (stainless steel, aluminum, galvanized or plated steel, or other approved materials).

B. Hardware in contact with aluminum handrails, plates or structural members and all hardware in exterior, wet or corrosive areas shall be type 316 stainless steel or aluminum (with bitumastic paint coating to isolate aluminum from contact with concrete where necessary) unless specifically noted otherwise.

C. Supports in exterior, process, wet or corrosive locations shall be type 316 stainless steel or aluminum (with bitumastic paint coating to isolate aluminum from contact with concrete where necessary) unless specifically noted otherwise.

D. Supports in extremely corrosive environments (such as chlorine or fluoride storage rooms) shall be PVC-Coated steel unless specifically noted otherwise.

E. Hardware and conduit clamps shall be as manufactured by Efcor, Steel City, G.A., Tinnerman or equal.

2.5 WATERTIGHT ENTRANCE SEAL DEVICES

A. For new construction, seal devices shall consist of oversized sleeve and malleable iron body with sealing rings, pressure rings, sealing grommets and pressure clamps as required (O-Z/Gedney type FSK/WSK or equal).

B. For cored-hole applications, seal devices shall consist of assembled dual pressure disks with neoprene sealing rings and membrane clamps as required (O-Z/Gedney type CSM or equal).

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Minimum Diameter: 3/4-inch.

B. Raceway Type: Raceway types shall be as specified below, unless indicated otherwise on drawings:
   1. Exterior, Exposed: Rigid Aluminum unless otherwise noted.
   2. Exterior, Used for Instrumentation Circuits: See Below.
   3. Other Exterior (Concrete-Encased or Direct Earth Buried): Schedule 40 PVC. PVC conduit shall convert to metallic conduit prior to exiting concrete-encasement or direct earth burial. See "transition" items below for additional requirements. Conduits shall be left exposed until after Engineer's observation.
   4. Interior, Exposed:
      a. Hazardous Locations: Rigid Aluminum .
      b. Wet Locations (including, but not limited to, Pump Rooms, Areas with exposed piping, Dewatering Rooms, Wet Wells, Underground Vaults, and other similar locations): Rigid Aluminum .
      c. Dry Locations: Rigid Aluminum.
      d. Extremely Corrosive Locations (Chlorine Storage Rooms, Fluoride Storage Rooms and other similar areas): Schedule 80 PVC.
   5. Interior, Concealed:
      a. Embedded inside Poured Concrete Walls, Ceilings or Floors, with a minimum of 2" of concrete between finished surface and outer wall of conduit on all sides, where no anchor bolts, screws or other similar items will be installed: Schedule 40 PVC. PVC conduit shall convert to metallic conduit (exact type as specified elsewhere within this section) prior to exiting poured concrete-encasement of wall, ceiling, floor or ductbank. See "transition" items below for additional requirements.
      b. Other Raceways Embedded inside Poured Concrete Walls, Ceilings or Floors (not meeting requirements above): PVC-Coated Rigid Steel
      c. Other Raceways: E.M.T.
   6. Raceways used for Instrumentation Circuits:
      a. Typical Dry or Wet Locations: Rigid Aluminum .
      b. Underground or Locations Embedded inside Poured Concrete: PVC-Coated Rigid Steel.
      c. Extremely Corrosive Locations (Chlorine Storage Rooms, Fluoride Storage Rooms and other similar areas): PVC-Coated Rigid Steel.
   7. Terminations at motors, transformers and other equipment which has moving or vibrating parts:
      a. Exterior or Wet Locations (including, but not limited to, Pump Rooms, Wet Wells, Underground Vaults, and other similar locations): Aluminum-Core Liquidtight Flexible Metallic Conduit (shall generally not exceed 24 inches in length) with watertight fittings.
      b. Dry, Interior Locations: Flexible Metallic Conduit (shall generally not exceed 24 inches in length).
   8. Terminations at instruments:
      a. Aluminum-Core Liquidtight Flexible Metallic Conduit (shall generally not exceed 12 inches in length) with watertight fittings.

9. Terminations at fixtures mounted in grid-type ceilings:
   a. Flexible Metallic Conduit or MC cabling (shall generally not exceed 72 inches in length and shall run from junction box to fixture, not from fixture to fixture).
10. Transition from underground or concrete-encased to exposed:
   a. Convert PVC to PVC-Coated Rigid Steel utilizing PVC-Coated Rigid Steel 90 degree bends (and vertical conduits as required by application) prior to exiting concrete/grade (except at outdoor pull boxes and under freestanding electrical equipment, where terminations shall be by PVC end bells installed flush with top of slab). Exposed portions of these coated conduits shall extend a minimum of 6" above floor level, and shall be installed at uniform heights.

3.2 RACEWAY INSTALLATION

A. General:
1. Follow methods which are appropriate and approved for the location and conditions involved. Where not otherwise shown, specified, or approved in a particular case, run all wiring concealed.
2. Where conduit crosses a structural expansion joint an approved conduit expansion fitting shall be installed.
3. Where any run of rigid aluminum conduit (including bends) exceeds 50' in length, an approved conduit expansion fitting shall be installed (beginning at center of run) at intervals not to exceed 50' on center.
4. A non-conductive polypropylene pull string, properly tied/secured at either end, shall be installed in all empty conduits.
5. Metal conduit field-cuts shall be cut square with a hacksaw and the ends reamed after threading.
6. PVC conduit field-cuts shall be made with hacksaw, and ends shall be deburred.
7. All PVC joints shall be made as follows:
   a. Clean the outside of the conduit to depth of the socket, and the inside of socket with an approved cleaner.
   b. Apply solvent cement as recommended by the conduit manufacturer to the interior of the socket and exterior of conduit, making sure to coat all surfaces to be joined.
   c. Insert conduit into the socket and rotate 1/4 to 1/2 turn and allow to dry.
8. All metallic conduit installed below grade or within concrete shall be painted with two (2) coats of asphaltum paint prior to installation.
9. Install ground wire sized per N.E.C. Table 250.122 in all conduits.
10. Use of running threads is absolutely prohibited. Conduit shall be jointed with approved threaded conduit couplings. Threadless and clamp type not acceptable.
11. Conduits shall be sized in accordance with latest National Electrical Code except when size shown on drawings.
12. Exposed, field-cut threads on all metal conduits shall be painted with zinc primer (for Galvanized Rigid or I.M.C.) or urethane paint (for PVC-Coated Rigid Steel) as recommended by conduit manufacturer .
13. Installation of PVC coated conduit systems shall be performed in strict accordance with the manufacturer's installation instructions. Damage to PVC coated conduit coating shall be touched up with patching compound as directed by manufacturer. To assure

correct installation, the installer shall be certified by the manufacturer to install coated conduit.

B. Routing/Locating:
1. Exposed conduit runs shall be run level and plumb and shall, on interior of buildings, be run parallel and/or at right angles to building walls and/or partitions.
2. Conduit with an external diameter larger than 1/3 the thickness of a concrete slab shall not be placed in the slab. Conduits in slab shall not be spaced closer than 3 diameters on center.
3. Conduit run in ceiling spaces shall be run as high as possible, all at same level, and shall be supported from building structure. Do not support conduit from any other installation.
4. Install conduit runs to avoid proximity to steam or hot water pipes. In no place shall a conduit be run within 6" of such pipes except where crossing is unavoidable, then conduit shall be kept at least 3" from the covering of the pipe crossed.
5. Before installing raceways for motors, HVAC equipment and other fixed equipment, check location of all equipment connections/terminal boxes with equipment supplier and locate and arrange raceways appropriately.
6. No conduit for instrumentation shall be run closer than 12 inches to parallel power conduits.
7. A minimum of 12" of clearance shall be provided between the finished lines of exterior, underground conduit runs and exterior, underground utilities (gas, water, sewer, etc.).

C. Bends:
1. Do not make bends (in any raceway, including flexible conduits) that exceed allowable conductor bending radius of cable to be installed or that significantly restrict conductor flexibility.
2. All bends within concrete-encased ductbanks installed in exterior locations shall be long radius bends (24" minimum bending radius – varies with conduit diameter).
3. All bends in raceways containing multi-conductor power cables (such as shielded VFD cables) shall be long radius bends (24" minimum bending radius – varies with conduit diameter).
4. Where numerous exposed bends or grouped together, all bends shall be parallel, with same center and shall be similar in appearance
5. All PVC elbows, bends, etc., shall be either factory bends or made with an approved heat bender.

D. Support:
1. Anchor conduit securely in place by means of approved conduit clamps, hangers, supports and fastenings. Arrangement and methods of fastening all conduits shall be subject to Engineer's direction and approval. All conduits shall be rigidly supported (wire supports may not be used in any location). Use only approved clamps on exposed conduit.
2. Rigid Aluminum Conduits shall be supported at intervals not to exceed 5' on center.
3. Conduit in riser shafts shall be supported at each floor level by approved clamp hangers.

4. Right angle beam clamps and U bolts shall be specially formed and sized to snugly fit the outside diameters of conduits.
5. Where installed in seismic zones, suspended raceways shall be braced in two (2) directions as required to prevent swaying and excessive movement.
6. Raceways installed on top of flat roofing shall be supported a minimum of 3 ½" above roof with rubber block supports (Cooper B-Line Dura-Blok or equal). Installation shall be in strict accordance with support manufacturer's instructions and recommendations.

E. Terminations:
1. All conduit connections to sheet metal cabinets or enclosures located in exterior or wet locations shall terminate by use of rain tight hubs.
2. Where rigid or I.M.C. conduits enter sheet metal boxes, they shall be secured by approved lock nuts and bushings.
3. Where metal conduits enter outdoor pull boxes, manholes, under freestanding electrical equipment or other locations where direct metal-to-metal contact does not exist between enclosure and conduit, grounding bushings shall be installed. Each grounding bushing shall be connected to the enclosure ground and all other grounding bushings with properly sized grounding conductors.
4. Where E.M.T. enters sheet metal boxes they shall be secured in place with approved insulating fittings.
5. Where PVC enters outdoor pull boxes, manholes or under freestanding electrical equipment, PVC end bells shall be installed.
6. Conduit ends shall be carefully plugged during construction.
7. Permanent, removable caps or plugs shall be installed on each end of all empty raceways with fittings listed to prevent water and other foreign matter from entering the conduit system.

F. Penetrations:
1. All fire/smoke barrier penetrations shall be made in accordance with a U.L. listed assembly. Refer to drawings and other specifications for additional requirements.
2. All penetrations shall be at right angles unless shown otherwise.
3. Structural members (including footings and beams) shall not be notched or penetrated for the installation of electrical raceways unless noted otherwise without specific approval of the structural engineer.
4. Dry-packed non-shrink grout or watertight seal devices shall be used to seal openings around conduits at all penetrations through concrete walls, ceilings or aboveground floors.
5. All raceways entering structures shall be sealed (at the first box or outlet) with polyurethane grout compound that expands to form a flexible foam seal that prevents the entrance of gases or liquids from one area to another (Prime Resins Prime-Flex or equal).
6. All raceways passing through concrete roofs or membrane-waterproofed walls or floors shall be provided with watertight seals as follows:

a. Where ducts are concrete encased on one side: Install watertight entrance seal device on the accessible side of roof/wall/floor as directed by equipment manufacturer.
b. Where ducts are accessible on both sides: Install watertight entrance seal device on each side of roof/wall/floor as directed by equipment manufacturer.

7. All raceways passing through walls of rooms containing/storing noxious chemicals (chlorine, ammonia, etc.) or through hazardous locations shall be sealed with conduit seals (Crouse-Hinds type EYS or equal).
8. All raceways terminating into electrical enclosures/devices/panels/etc. located in hazardous locations shall be sealed with conduit seals (Crouse-Hinds type EYS or equal) within 18" of the termination.

G. Exterior Electrical Ductbanks:

1. Where exterior electrical concrete-encased ductbanks are indicated on drawings, conduit runs between buildings or structures shall be grouped in concrete-encased ductbanks as follows:
   a. A minimum of 3" of concrete shall encase each side of all ductbanks.
   b. A minimum of 1 ½" of separation shall be provided between each conduit within ductbanks. PVC spacers shall be installed at the necessary intervals prior to placement of concrete to maintain the required spacing and to prevent bending or displacement of the conduits.
   c. Top of concrete shall be a minimum of 30" below grade. A continuous magnetic marking tape shall be buried directly above each ductbank, 12" below grade.
   d. Exact routing of ductbanks shall be field verified and shall be modified as necessary to avoid obstruction or conflicts.
   e. Underground electrical raceways shall be installed to meet the minimum cover requirements listed in NEC Table 300.5. Refer to drawings for more stringent requirements.

END OF SECTION 26 05 33

SECTION 26 05 34 – OUTLET BOXES, JUNCTION BOXES, WIREWAYS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Outlet and Junction Boxes

B. Pull Boxes

C. Wireways

PART 2 - PRODUCTS

2.1 OUTLET BOXES & JUNCTION BOXES (THROUGH 4-11/16")

A. Sheet Metal: Shall be standard type with knockouts made of hot dipped galvanized steel as manufactured by Steel City, Raco, Appleton, Bowers or equal.

B. Cast: Shall be type FS, FD, JB, GS, or SEH as required for application as manufactured by O-Z/Gedney, Appleton, or equal.

C. Nonmetallic: Shall be type Polycarbonate/ABS construction as required for application with non-metallic quick-release latches as manufactured by Hoffman, O-Z/Gedney, Appleton, or equal.

2.2 JUNCTION AND PULL BOXES (LARGER THAN 4-11/16")

A. Oil-Tight JIC: Shall be Hoffman Type CH box or approved equal.

B. Galvanized Cast Iron or Cast Aluminum: Shall be O-Z/Gedney or approved equal.

C. Stainless Steel: Shall be as manufactured by O-Z/Gedney, Hoffman or approved equal. Boxes shall have continuous hinges, seamless foam-in-place gaskets and screw-down clamps.

D. Nonmetallic: Shall be type Polycarbonate/ABS construction as required for application with non-metallic quick-release latches as manufactured by Hoffman, O-Z/Gedney, Appleton, or equal.

E. Wireways: Shall be standard manufacturer's item as manufactured by Hoffman, Square "D", Burns, B & C or equal.

F. Pre-cast Polymer Concrete Below-Grade Hand Holes & Pull Boxes:
   1. Enclosures, boxes and cover are required to be UL Listed and conform to all test provisions of ANSI/SCTE 77 "Specifications For Underground Enclosure Integrity" for

Tier 15 applications (15,000lb design load and 22,500lb test load) unless noted otherwise.

2. All covers shall have a minimum coefficient of friction of 0.05 in accordance with ASTM C1028 and the corresponding Tier level shall be embossed on the top surface.
3. Cover shall be bolt-down include factory-labeling to read “Electric”, “Communications” or other as directed.
4. Hardware shall be stainless steel.
5. Shall be Quazite PG/LG Style or approved equal.

G. Galvanized Cast Iron Below-Grade Pull Boxes:
1. Enclosures, boxes and cover are required to conform to AASHTO H-20 requirements for deliberate vehicular traffic applications unless noted otherwise.
2. Cover shall be checkered, bolt-down include factory-labeling to read “Electric”, “Communications” or other as directed.
3. Hardware shall be stainless steel.
4. Shall be furnished with grounding kit.
5. Shall be O-Z/Gedney Type YR or approved equal.

H. Above-Grade Padmounted Low Profile Pull Boxes:
1. Construction:
   a. 12Ga. stainless steel base with 14Ga stainless steel top with brushed finish, and structural bracing as required.
   b. Continuous base frame with open bottom and eight (8) ½” x 1” slots for securing box to concrete pad below and a center support member.
   c. Two (2) full-size swing-open lids with full-length, stainless steel continuous hinges, lifting handles, key-locking provisions and provisions for latching lids in open position (with stainless steel chain or approved equal).
   d. Guides on lid and base frame as required to insure proper closing of box and to provide increased security.
   e. Stainless steel barrier between power & instrumentation areas within box if box is used for both power and instrumentation wiring.
   f. Other stainless steel hardware as required.
2. Minimum Dimensions:
   a. Power: 40 inches square x 18 inches high.
   b. Instrumentation: 24 inches square x 18 inches high.
3. Manufacturer:
   a. Electrical Enclosure Mfg. (Pell City, AL).
   b. Ebox (Pelham, AL).
   c. Approved Equal.

PART 3 - EXECUTION

3.1 APPLICATION

A. General

1. All boxes and wireways shall be of sufficient size to provide free space for all enclosed conductors per NEC requirements. Fill calculations shall be performed by contractor per NEC requirements.

B. Outlet Boxes & Junction Boxes (through 4-11/16”)
1. Sheet metal boxes shall be used on concealed work in ceiling or walls.
2. Cast boxes shall be used wherever Rigid or I.M.C. conduits are installed.
3. All boxes installed in extremely corrosive areas (such as chlorine and fluoride storage rooms) where non-metallic raceways are used shall be non-metallic.
4. Except when located in exposed concrete block, switch and receptacle boxes shall be 4" square for single gang installation. Appropriate gang boxes shall be used for mounting ganged switches.
5. When installed in exposed concrete block, switch and receptacle boxes shall be square type designed for exposed block installation.
6. Ceiling outlet boxes shall be 4" octagon 1-1/2" deep or larger required due to number of wires.
7. Boxes installed in hazardous locations shall be explosion-proof rated for the associated application, constructed of copper-free cast aluminum.

C. Junction & Pull Boxes (larger than 4-11/16”)
1. For all below grade exterior use and elsewhere as shown:
   a. In areas subject to future vehicular traffic: shall be galvanized cast iron (rated AASHTO H-20 Loading unless noted otherwise).
   b. In areas not subject to vehicular traffic: shall be galvanized cast iron or pre-cast polymer concrete (rated for Tier 15 Loading unless noted otherwise).
2. All boxes installed exposed in exterior or wet areas shall be stainless steel (NEMA 4X).
3. All boxes installed exposed in corrosive areas shall be stainless steel (NEMA 4X).
4. All boxes installed in extremely corrosive areas (such as chlorine and fluoride storage rooms) where non-metallic raceways are used shall be non-metallic.
5. Boxes installed in hazardous locations shall be explosion-proof rated for the associated application, constructed of copper-free cast aluminum.
6. All others shall be oil tight JIC box not less than 16 gauge.

3.2 INSTALLATION

A. General
1. All boxes and wireways shall be securely anchored.
2. All boxes shall be properly sealed and protected during construction and shall be cleaned of all foreign matter before conductors are installed.
3. All boxes and wireways shall be readily accessible. Contractor shall be responsible for furnishing and installing access panels as directed by the architect as required to make boxes and wireways accessible where above gypsum board ceilings or in other similar locations.
4. All metallic boxes and wireways shall be properly grounded.
5. Refer to Specification Section 26 05 53 for identification requirements.

B. Outlet Boxes & Junction Boxes (through 4-11/16”)
   1. Boxes shall be provided with approved 3/8" fixture studs were required.
   2. Recessed boxes for wiring devices, surface fixtures, or connections, shall be set so that the edge of cover comes flush with finished surface.
   3. There shall be no more knockouts opened in any sheet metal box than actually used.
   4. Any unused opening in cast boxes shall be plugged.
   5. Back to back boxes to be staggered at least 3 inches.
   6. Under no circumstances shall through-the-wall boxes be used.

C. Junction & Pull Boxes (larger than 4-11/16”)
   1. Pull boxes shall be installed as indicated on plans and/or as required due to number of bends, distance or pulling conditions.
   2. Boxes to be imbedded in concrete shall be properly leveled and anchored in place before the concrete is poured.
   3. All pull boxes and/or junction boxes installed exterior below grade, shall have their tops a minimum of 1-1/2 inches above surrounding grade and sloped so that water will not stand on lid. A positive drain shall be installed, to prevent water accumulation inside.

D. Wireways and/or wall-mounted equipment
   1. Mount each wireway to channels of the same metal type as the wireway.
   2. Conductors serving a wireway shall be extended without reduction in size, for the entire length of the wireway. Tap-offs to switches and other items served by the wireway shall be made with ILSCO type GTA with GTC cap.

END OF SECTION 26 05 34

SECTION 26 05 53 – ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Wire and cable identification.

B. Pullbox & Junction Box Identification

C. Electrical distribution & utilization equipment identification.

D. Emergency and Standby Power receptacle identification.

E. Instrument and control device identification.

F. Raceway identification.

PART 2 - PRODUCTS

2.1 WIRE AND CABLE IDENTIFICATION

A. Intermediate Locations:
   1. Wires and cable labels shall be white, thermal transfer, halogen-free, flame-retardant marker plates (sized to accommodate three lines of text) permanently affixed to the associated cable with UV-resistant plastic wire ties. Labels shall be Panduit #M200X/300X series or equal.

B. Circuit/Cable Termination Locations:
   1. Wires and cable labels shall be non-ferrous identifying tags or pressure sensitive labels unless noted otherwise.

2.2 ELECTRICAL DISTRIBUTION & UTILIZATION EQUIPMENT IDENTIFICATION

A. Labels on electrical distribution & utilization equipment shall be black-on-white engraved Bakelite nameplates permanently affixed to the equipment with rivets or silicone adhesive unless noted otherwise.

2.3 INSTRUMENT AND CONTROL DEVICE IDENTIFICATION

A. Instruments and control device labels shall be black-on-white engraved Bakelite nameplates permanently affixed to the equipment or the adjacent, visible mounting surface with silicone adhesive or stainless steel wire ties.

PART 3 - EXECUTION

3.1 GENERAL

A. Any proposed deviation in identification methods and materials from those described herein shall be submitted to Engineer for review and comment prior to installation.

B. Contractor shall provide all labeling or identification required by applicable local, state and national codes. These specifications do not intend to itemize all code-required labeling or identification requirements.

C. All labels/identification shall be positioned such as to be readable from the normal perspective without adjusting wiring/cables/labels. For example, labels/identification of wires/cables within cable trays shall be positioned to point towards the viewer (typically downward for overhead cable trays, or upward for cable trays within trenches).

D. All labels/identification (except for handwritten labels on concealed pullbox/junction box covers as noted below) shall be typewritten/printed/engraved in a neat, workmanlike, permanent, legible, consistent and meaningful manner. Labels shall not be handwritten unless specific approval is granted by engineer.

3.2 WIRE AND CABLE IDENTIFICATION

A. General:
   1. Where cabling is exposed (such as within cable trays), provide two wire ties per cable (one on either end of marker plate to provide a flush installation). Where cabling is concealed (such as within pullboxes/wireways), one wire tie per cable will be acceptable.

B. Intermediate Locations:
   1. Thermal transfer labels shall be securely fastened to all wiring and cabling in the following locations:
      a. Wireways
      b. Pullboxes/Junction boxes larger than 4-11/16”
      c. Pullboxes/Junction boxes through 4-11/16” where wires and cables are not easily identifiable via the color coding and box labeling
      d. Vaults & Manholes
      e. Approximately every 50 feet within cable trays (especially at locations where cables exit or diverge). Labels within cable trays shall be grouped (rather than being pre-labeled on cables and pulled into cable trays).
      f. Other similar intermediate locations.
   2. Labels shall be stamped or printed with the following data so that the feeder or cable can be readily identified and traced:
      a. From where the circuit originates (including panel designation and circuit number):
         1) Ex: “FROM: PP-A CIR. 3 (IN MAIN ELEC ROOM)”
      b. To where the circuit extends (using the common name of the equipment):
         1) Ex: “TO: RTU-6 (ON ROOF)”
      c. The purpose of the circuit:
         1) Ex: “POWER”
      d. The set number (If parallel power feeds are used).

1) Ex: “SET NO. 3 OF 4”

C. Circuit/Cable Termination Locations:
1. Where multiple termination points exist within a circuit origination point (panelboard, switchboard, MCC, starter, etc.) or other similar circuit endpoint (control panel, etc.), labels shall be securely fastened to all ungrounded and neutral conductors to clearly identify the terminal and/or circuit number associated with each conductor. For example, within lighting panels, each phase and neutral conductor shall be labeled near the terminals at a clearly visible location with the associated circuit number(s), so that if all conductors were unterminated, the labels would clearly indicate which conductor was associated with each circuit.

D. Refer to Specification Section 26 05 19 for all color-coding requirements of wires and cables.

3.3 PULLBOX & JUNCTION BOX IDENTIFICATION

A. Concealed pullboxes/junction boxes:
1. Front surface of all pullbox/junction box covers in concealed areas (such as above lay-in ceilings) or within mechanical/electrical rooms (and other similar areas where appearance of boxes is not an issue) shall be neatly marked with the ID of circuits/cables contained with permanent black marker on cover of box (Ex: “RP-1A Cir. 1, 2 & 3”). Additionally, front surface of box shall be painted red where box contains fire alarm system cabling.

B. Exposed pullboxes/junction boxes:
1. Interior surface of all pullbox/junction box covers in exposed areas shall be labeled “Power”, “Telecommunications”, “Fire Alarm” or with other similar general text neatly with permanent black marker to indicate function of box. Circuit/cable labeling within box (see above) shall identify specific cables contained. Additionally, interior surface of cover shall be painted red where box contains fire alarm system cabling.

C. Where pullboxes/junction boxes are named on contract documents (Ex:”PULLBOX #3”), an engraved nameplate shall be installed on the front surface of the box to identify the name.

3.4 ELECTRICAL DISTRIBUTION & UTILIZATION EQUIPMENT IDENTIFICATION

A. General:
1. All new and existing equipment modified by this project shall include arc-flash warning labels in accordance with NEC article 110.16.

B. All Panels, Motor Control Centers, Switchboards, Switchgear, Transformers, Etc.:
1. Engraved nameplates identifying name of equipment, nominal voltage and phase of the equipment and where the equipment is fed from shall be installed on front surface of all panels, motor control centers, switchboards, switchgear, transformers, etc.:
a. Ex: First Line: “NAME: RP-A”, Second Line: “120/208V-3Ø-4W”, Third Line: “FED FROM: PP-A CIR. 4 (IN MAIN ELEC ROOM)”

2. Refer to Panelboard Specification Sections for additional labeling requirements (circuit directory cards, permanent circuit labels, permanent circuit numbers, etc.) required inside panelboards.

C. Safety/Disconnect Switches and Utilization Equipment (HVAC Equipment, Control Panels, Starters, Etc.)::
   1. Engraved nameplates identifying equipment being fed and where the equipment is fed from shall be installed on front surface of all disconnect switches (including both visible blade type switches and toggle-type switches) and on utilization equipment (where not clearly identified by immediately adjacent local disconnect switch):
      a. Ex: First Line: “RTU-6”, Second Line: “FED FROM: PP-A CIR. 5”
   2. Where safety/disconnect switches are installed on the load side of variable frequency drives, the safety/disconnect switch shall be furnished with an additional engraved nameplate to read: “WARNING: TURN OFF VFD PRIOR TO OPENING THIS SWITCH”.
   3. Safety/Disconnect switches feeding equipment that is fed from multiple sources (such as motors with integral overtemperature contacts that are monitored via a control system) and Utilization Equipment fed from multiple sources shall be furnished with an additional BLACK-ON-YELLOW engraved nameplate to read: “WARNING: ASSOCIATED EQUIPMENT FED FROM MULTIPLE SOURCES – DISCONNECT ALL SOURCES PRIOR TO OPENING COVER”.

3.5 INSTRUMENT AND CONTROL DEVICE IDENTIFICATION

A. New Instruments and control devices (whether furnished by contractor or not) shall be labeled with black-on-white engraved nameplates permanently affixed to the equipment or to the adjacent, readily-visible mounting surface with silicone adhesive or stainless steel wire ties.
   1. Instruments and process control devices (float switches, etc.) shall be labeled with instrument name and, where available, instrument ID number.
   2. Pushbutton stations shall be labeled with equipment being controlled. Labels shall be installed on front surface (or adjacent mounting surface) of all pushbutton stations.
   3. Thermostats and other similar HVAC control devices installed in process areas shall be labeled with equipment being controlled. Labels shall be installed on front surface (or adjacent mounting surface) of all thermostats and other similar HVAC control devices.

3.6 OTHER IDENTIFICATION

A. Factory-engraved coverplates identifying functions of light switches and other similar devices shall be installed where so required by plans/specifications.

END OF SECTION 26 05 53

SECTION 26 29 00 – MANUFACTURED CONTROL PANELS

PART 1 - GENERAL

1.1 SCOPE

A. This section describes control stations, PLC panels, motor control panels, manufactured control panels, and other similar panels specified herein. Specifications herein are intended as an extension of requirements in other Divisions of these specifications where reference is made to Electrical Specifications.

1.2 DEFINITIONS

A. "Control Stations": Enclosures (with all required accessories) containing only door-mounted pushbuttons, indicator lights and/or selector switches (no electronic components or starter/controller equipment).

B. "Control Panels": Enclosures (with all required accessories) containing equipment/devices other than door-mounted pushbuttons, indicator lights and/or selector switches (such as electronic components, starter/controller equipment, etc.).

1.3 SUBMITTALS

A. Provide the following for each control panel:
   1. A job-specific, custom wiring diagram
      a. The wiring diagram shall clearly show all components (whether the components are mounted internal or external to the control panel enclosure).
      b. All wires and terminal blocks shall be clearly labeled.
      c. Diagram shall be in accordance with NEMA/ICS standards.
   2. Size, type and rating of all system components.
   3. Unit frontal elevation and dimension drawings.
   4. Internal component layout diagrams.
   5. Manufacturer's product data sheets for all components.

B. A Bill of Materials shall be included with catalog information on all components.

C. Information shall be included on any proprietary logic component sufficient to demonstrate its ability to perform the required functions.

D. The following calculations shall be submitted:
   1. Thermal calculations showing amount of air conditioning and heating required for each control panel, per ambient requirements listed below and operating temperature limitations of all equipment/devices within each control panel.
      a. Thermal calculations used for sizing cooling systems for each control panel located in exterior or non-conditioned spaces shall assume:
         1) Ambient exterior air temperature ranges of -5 degrees F to 105 degrees F.

2) Full solar contact where applicable.
3) No wind.
4) Heat loss from interior equipment (electronics, etc.) per equipment supplier's information.

b. Thermal calculations used for sizing heating systems for each control panel shall assume:
1) Ambient exterior air temperature ranges of -5 degrees F to 105 degrees F.
2) No heat loss by interior components of control panel.
3) No solar gain on exterior of control panel.
4) Doubling of heating wattage required to account for wind where control panels are located outdoors.
5) Minimum temperature difference (due to heating) of 10 degrees F to prevent condensation, regardless of equipment temperature limitations.

2. Load calculations showing the sizing of all power supplies provided (with spare capacity as specified).
3. Load calculations showing the sizing and anticipated runtime of all Uninterruptible Power Supply systems provided (with spare capacity as specified).

PART 2 - PRODUCTS

2.1 GENERAL

A. Control panels shall be Underwriters' Laboratories labeled by the panel manufacturer. Control panel manufacturers not capable of applying the U.L. label to their products are unacceptable.

B. All human interface equipment/devices (indicator lights, selector switches, pushbuttons, time switches, displays, keypads, and other similar items used for control, adjustments or monitoring) shall be mounted on the non-energized side of enclosure door(s) in such a way as to be accessible without exposing the user to energized parts.

2.2 RATINGS

A. All Control Panels shall have short circuit current ratings at least equal to the lesser of the following:
1. The short circuit current rating of the electrical distribution equipment that feeds the Control Panel.
2. 150% of the available fault current at the Control Panel as determined by a Short Circuit Current study prepared by a licensed professional electrical engineer.

B. All equipment/devices installed within control panels shall be rated to operate in ambient temperatures of 50 degrees C (122 degrees F) or higher.

2.3 ENCLOSURES

A. All enclosures (with any required accessories or auxiliary items) shall fit within the space shown on the Plans. Any costs associated with furnishing equipment which exceeds the

available space shall be borne by the Contractor.

B. Enclosures (with any required accessories or auxiliary items) shall be suitable for the environment where installed.

C. Enclosure materials shall be as follows unless noted otherwise:
   1. Control Stations:
      a. Where located in extremely corrosive areas (chlorine rooms, fluoride rooms, etc.): NEMA 4X of non-metallic construction (with non-metallic hardware) compatible with the associated chemical(s).
      b. Where located in other wet, process or outdoor areas: NEMA 4X of type 304 stainless steel construction (with stainless steel hardware).
      c. Where located in dry, non-process, indoor areas (such as electrical rooms): NEMA 1 of die cast zinc/aluminum construction.
   2. Control Panels:
      a. Where located in extremely corrosive areas (chlorine rooms, fluoride rooms, etc.): NEMA 4X of non-metallic construction (with non-metallic hardware) compatible with the associated chemical(s).
      b. Where located in other wet, process or outdoor areas: NEMA 4X of type 316 stainless steel construction (with stainless steel hardware).
      c. Where located in dry, non-process, indoor areas (such as electrical rooms): NEMA 1 or 12.

D. Control Panel Enclosure Construction:
   1. Non-metallic control panel enclosure material, where specified, shall be reinforced polyester resin or equivalent, with a minimum thickness of 3/16 inch for all surfaces except those requiring reinforcement. Panels shall be precision molded to form a one piece unit with all corners rounded. Exterior surfaces shall be gel-coated to provide a corrosion-resistant maintenance-free satin finish which shall never need painting. Color pigments shall be molded into the resin. Color shall be grey.
   2. Metallic control panel enclosures, where specified, shall be fabricated using a minimum of 14 gauge steel for wall or frame mounted enclosures and a minimum of 12 gauge for freestanding enclosures. Continuously weld all exterior seams and grind smooth. Reinforce sheet steel with steel angles where necessary support equipment and ensure rigidity and preclude resonant vibrations.
   3. Use pan-type construction for doors.
   4. Door widths shall not exceed 36-inches.
   5. Mount doors with full length, heavy duty piano hinge with hinge pins.
   6. Provide gasket completely around each door opening.
   7. Mount and secure all internal components to removable back plate assembly.
   8. For NEMA 1 or 12 enclosures, provide handle-operated key-lockable three point stainless steel latching system for each door.
   9. For NEMA 4X enclosures, provide provisions for padlocking all doors and provide clamps on three (3) sides of each door.

2.4 CONTROL PANEL ACCESSORIES:

A. Cooling systems shall be provided if so required by the application to maintain temperatures within the acceptable ranges of the interior equipment. In no case (regardless of temperature ratings of internal equipment) shall maximum temperatures within control panels be allowed to exceed 50 degrees C (122 degrees F). Thermostats shall be provided to control cooling without need of manual operation. Thermostat setpoints shall be as per recommendations of the equipment suppliers. See above for thermal calculation requirements. Cooling units shall be as manufactured by Hoffman Engineering Co., Rittal or approved equal and shall be thermostatically controlled.

B. Space heaters shall be provided for condensation and temperature control. Thermostats AND hygrostats (or combination hygrotherm controllers) shall be provided to control heating requirements (based on temperature and relative humidity within enclosure) without need of manual operation. Setpoints shall be as per recommendations of the equipment suppliers. See above for thermal calculation requirements. Space heaters and associated control devices shall be as manufactured by Hoffman Engineering Co., Rittal, Stego or approved equal.

C. Solar shields shall be provided where required due to equipment heating or solar loading.

D. Provide a sun shield over all LCD displays in exterior-mounted panels.

E. Provide a clear polycarbonate gasketted hinged door or window to encompass all indicators, controllers, recorders, etc. mounted on NEMA 4 and 4X enclosures.

F. Provide interior mounting panels and shelves constructed of minimum 12 gauge steel with white enamel finish. Provide metal print pocket with white enamel finish on inside of door.

G. Provide interior fluorescent or LED light kit, mounted at top of interior of panel, and switched to turn “ON” when door is opened for all control panels.

H. Control panels containing VFDs or Reduced Voltage Soft Starters shall include a door mounted digital keypad for adjusting the starter parameters and viewing process values and viewing the motor and starter statuses without opening the enclosure door.

2.5 CONTROL COMPONENTS

A. General:
   1. All pushbuttons, pilot lights, selector switches and other control devices shall be separate, standard size (full 30mm) and shape, heavy duty oil-tight units.
      a. Devices in extremely corrosive areas (chlorine rooms, fluoride rooms, etc.) shall be of non-metallic construction.
      b. Devices in other areas shall be of chrome-plated construction.
   2. All components and devices so that connection can be easily made and so there is ample room for servicing each item.
   3. Door-mounted indicators, recorders, totalizers and controllers shall be located between 48” and 72” above finished floor level.

4. Door-mounted indicator lights, selector switches and pushbuttons shall be located between 36" and 80" above finished floor level.
5. All devices and components shall be adequately supported to prevent movement. Mounting strips shall be used to mount relays, timers and other devices suitable for this type of mounting.

B. Pilot Lights:
1. All pilot lights to be cluster LED type & push to test.

C. Pushbuttons:
1. All STOP operators within control stations located at equipment shall be provided with lockout provisions and a minimum of two (2) sets of contact blocks.
2. Emergency shutoff pushbutton devices shall be as follows unless noted otherwise:
   a. 2 ¼" diameter, mushroom-style, maintained contact push buttons
   b. With a minimum of one (1) normally open dry contact and three normally closed dry contacts.
   c. Connections made such that pushing "in" the button will shutoff the associated equipment.
   d. Provided with a red engraved nameplate with ½" lettering to read "Emergency Shutoff".

D. Relays:
1. All relays in custom manufactured control panels, starter enclosures, etc. shall be NEMA-rated industrial control relays manufactured in accordance with NEMA Standard ICS2-212 with the following characteristics, unless noted otherwise:
   a. Minimum mechanical life of 10 million operations.
   b. Double-break contacts rated 10 amperes, resistive at 120 volts.
   c. Field-convertible/replaceable contacts (N.O./N.C.) and field-replaceable coil.
   d. Contacts as shown on wiring diagrams plus a minimum of one (1) spare N.O. contact and one (1) spare N.C. contact. Field-expandable to 12 contacts.
   e. Furnished with RC transient suppressor to suppress coil-generated transients to 200% of peak voltage.
   f. On/Off indicator.
   g. Equal to Square D type X.
2. Relays in manufactured control panels which are a standard, pre-engineered product of the manufacturer may be NEMA-rated industrial control or general purpose relays. General purpose relays shall have the following characteristics, unless noted otherwise:
   a. Minimum mechanical life of 10 million operations.
   b. Single-break contacts rated 10 amperes, resistive at 120 volts.
   c. Contacts as shown on wiring diagrams plus a minimum of one (1) spare N.O. contact and one (1) spare N.C. contact. At a minimum, each relay shall have 3PDT contacts.
   d. Furnished with RC transient suppressor to suppress coil-generated transients to 200% of peak voltage.
   e. LED on/off indicator light and manual operator.

f. Industry standard wiring and pin terminal arrangements.
g. Equal to Square D type 8501K.

3. Interposing/isolation relays used to isolate input/output field wiring from PLC inputs/outputs shall be terminal-block style. Terminal-block style relays shall have the following characteristics, unless noted otherwise:
   a. Minimum mechanical life of 10 million operations.
   b. Single-break contacts rated 6 amperes, resistive at 120 volts.
   c. One (1) N.O. contact per relay.
   d. Furnished with integral transient protection.
   e. LED on/off indicator light.
   f. DIN-rail mounted.
   g. Equal to Square D type Zelio RSL.
4. Timer relays shall be electronic, adjustable plug-in devices meeting the following characteristics, unless noted otherwise:
   a. Minimum mechanical life of 10 million operations.
   b. Single-break contacts rated 10 amperes, resistive at 120 volts.
   c. Contacts as shown on wiring diagrams plus a minimum of one (1) spare N.O. contact and one (1) spare N.C. contact. At a minimum, each relay shall have DPDT contacts (2 N.O. & 2N.C.).
   d. Rotary-thumbwheel adjustments for time value, timing range and function.
   e. Time value adjustments from .05 seconds to 999 hours
   f. Selectable Timing Functions, including the following:
      1) On Delay
      2) Interval
      3) Off Delay
      4) One Shot
      5) Repeat Cycle-Off
      6) Repeat Cycle-On
      7) On/Off Delay
      8) One Shot Falling Edge
      9) Watchdog
      10) Trigger On Delay
   g. Accuracy shall be $\pm$ 2% and repeatability shall be $\pm$ 0.1%.
   h. Furnished with integral transient protection.
   i. LED indicator light(s) for “timing” and “on/off status”
   j. Held in place with hold-down spring
   k. Equal to Square D type JCK70.

2.6 POWER SUPPLIES

A. Power supplies shall be provided where specified elsewhere, or as required by design of system. Power supplies shall be industrial type, AC-to-DC switching, output voltage as required, 120vac input, size as required for the initial application plus 50% spare capacity.

B. Redundant power supplies with diode isolation shall be provided so that the loss of one power supply does not affect system operation. The back-up supply systems shall be

designed so that either the primary or the back-up supply can be removed, repaired, and returned to service without disrupting the system operation.

C. Power supply output shall be protected by secondary overcurrent protection device(s).

D. The power distribution from multiloop supplies shall be selectively fused so that a fault in one instrument loop will be isolated from the other loops being fed from the same supply.

E. Each power supply shall meet the following requirements.
1. Regulation, line: 0.4% for input from 105 to 132vac.
2. Regulation, load: 0.8%
3. Ripple/Noise: 15mV RMS / 200 mV peak to peak
4. Operating temperature range: 0 deg C - 60 deg C
5. Overvoltage protection
6. Overload Protection
7. Output shall remain within regulation limits for a least 16ms after loss of AC power at full load.
8. Output status indicator.
9. UL listing

F. Power supplies shall be manufactured by Sola, Phoenix Contact or equal.

2.7 DISCONNECTS

A. A main disconnect switch or circuit breaker shall be supplied integral to all control panels.

B. Individual circuit breakers shall be provided integral to the manufactured control panel for each separate power circuit originating within the control panel.

C. Where the highest continuous current trip setting for which the actual overcurrent device installed in a circuit breaker is rated (or can be adjusted to is 1200A or higher, breakers shall be electronic trip and shall be provided with arc energy-reducing maintenance switching (with local status indicator) to reduce arc flash energy per NEC 240.87 requirements.

2.8 WIRING

A. Refer to Section 26 05 19 for all wiring types/applications.

B. All wiring shall be identified on each end with hot stamped or shrink tube type permanent wire markers to correspond with numbering shown on wiring diagrams.

C. All connections shall be made on terminals with no splices.

D. All wiring runs shall be along horizontal or vertical routes to present a neat appearance. Angled runs will not be acceptable. Group or bundle parallel runs of wire in plastic wire duct where practical.

E. All wiring runs shall be securely fastened to the panel or wire duct by means of plastic wire ties. Adequately support and restrain all wire runs to prevent sagging or movement.

F. AC power wiring and instrumentation/analog wiring shall be run separate.

G. Color code all internal wiring (not field wiring) as follows:
1. Line and load circuits: Black (B)
2. AC control wiring: Red (R)
3. Externally-Powered control wiring: Yellow (Y)
4. Neutral wiring: White (W)
5. Low voltage DC(+)pos: Blue (BL)
6. Low voltage DC(-)neg: Blue/White Tracer (BL/W)
7. Grounding: Green/Yellow Tracer (G/Y)

H. Insulated crimped style spade lugs shall be provided to connect wiring to screw type terminals on devices located inside enclosure and/or front panel mounted.

I. Terminal strips shall be provided for all input and output wiring. No more than two (2) wires shall be connected to one (1) terminal block.

2.9 ELECTRICAL SURGE AND TRANSIENT PROTECTION

A. General
1. Function: Protect the system against damage due to electrical surges.

B. Application: As a minimum, provide surge and transient protection (with proper grounding) at the following locations as described below:
1. Power Input:
a. Provide surge protection device at any connection of 120VAC power to panels containing programmable logic controllers, remote I/O equipment, UPS's, transmitters, radios, VFDs, Reduced Voltage Soft Starters or other electronic equipment. Device shall:
1) Be mounted internal to the associated panel, with dedicated overcurrent protection.
2) Be of two-part (base and SPD), DIN-rail mountable construction.
3) Have 15kA total nominal discharge current per line (based on 8/20µs waveform).
4) Have maximum continuous operating voltage (MCOV) rating as required by the associated circuit voltage.
5) Visually indicate operational status.
6) Be Dehn DEHNguard series or equal by MTL Technologies.
2. Analog I/O Panel Terminations:
a. Provide surge protection device at the PLC (or similar) panel connection of each analog I/O signal. Device shall:
1) Be mounted internal to the associated panel.
2) Be of two-part (base and SPD), DIN-rail mountable construction.

3) Have 10kA total nominal discharge current per line (based on 8/20µs waveform).
4) Have maximum continuous operating voltage (MCOV) rating as required by the associated signal.
5) Be Dehn Blitzductor XT series or equal by MTL Technologies.

3. Discrete I/O Panel Terminations:
   a. Provide isolation relay at the PLC (or similar) panel connection of each discrete I/O signal (within the associated panel). See above for isolation relay requirements.
4. Network Panel Terminations:
   a. Provide surge protection device at the PLC (or similar) panel connection of each network cable. Device shall:
      1) Be mounted internal to the associated panel.
      2) Be of DIN-rail mountable construction.
      3) Have 1kA total nominal discharge current per line (based on 8/20µs waveform).
      4) Be designed specifically for the associated network connection type (Ethernet, RS485, RS232, etc.).
      5) Be MTL Zonebarrier series or equal.
5. Antenna Cable Terminations:
   a. Provide surge protection device at the connection of antenna cable to the radio panel. Device shall:
      1) Be mounted internal to the associated panel.
      2) Provide coarse protection via replaceable gas-filled surge voltage arrestor
      3) Be Phoenix Contact COAXTRAB series or equal.

C. Installation and grounding of suppressor: As directed by manufacturer. Provide coordination and inspection of grounding.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide enclosure mounting supports as required for floor, frame or wall mounting. All supports in exterior, wet or process areas shall be stainless steel unless noted otherwise. All floor-mounted panels or other similar distribution equipment shall be mounted on 6" concrete housekeeping pads unless specifically shown otherwise.

B. All enclosures used outside shall be solid bottom unless otherwise specified. All cable and piping openings shall be sealed watertight. Cable and piping shall enter the enclosure as shown on drawings or specified herein.

C. All equipment and components shall be solidly grounded to the control panel. One grounded terminal unit shall be provided in each control panel for connection to plant ground system. Grounding digital and analog components shall be performed in accordance with the instrument supplier's installation recommendations. Signal ground shall be solidly connected to the ground system so as to prevent ground loops

3.2 PAINTING

A. For enclosures other than NEMA 4X stainless steel or fiberglass:
   1. Completely clean all surfaces so that they are free of corrosive residue. Then, phosphatize all surfaces for corrosion protection.
   2. Prime with two (2) coats and finish with one coat of factory finish textured polyurethane. Paint shall be Sherwin-Williams Polane “T’ or approved equal.
   3. Color to be selected during shop drawing review phase.

3.3 IDENTIFICATION & DOCUMENTATION

A. Refer to specification section 26 05 53 for additional requirements.

B. Control panel power supply source, type, voltage, number or circuit ratings shall be identified inside control panels and on drawings.

C. All interior devices and components shall be identified with thermal transfer labels with black letters on white background. Labels shall be placed on the subpanel and not the component. Marking system shall be a Brother “PTouch II” or equal. Lettering shall be 1/4" high.

D. All front panel mounted devices such as push buttons shall be identified by the use of engraved bakelite nameplates or legend plates. Nameplates shall be 1/8” thick, white with black core.

E. A job-specific, custom wiring diagram for each control panel (not including control stations without relays) shall be provided to the contractor prior to installation for making the appropriate electrical connections. The wiring diagram shall clearly show all control components connected to the panel (whether the components are mounted internal or external to the enclosure). All wires and terminal blocks shall be clearly labeled. A laminated copy of the final wiring diagram for each unit shall be installed inside the door of the associated panel, and submitted to the owner with the as-built documentation.

3.4 OWNER TRAINING

A. Fully train the owner in the proper operation of all control panels/equipment, describing and demonstrating full operation, including function of each door-mounted device.

3.5 SPARE EQUIPMENT

A. Provide the following spare equipment:
   1. Fuses: 10% (minimum of 3) of each size and type utilized, mounted within a pocket within the associated control panel.
   2. Where control panel contains programmable controller (or similar equipment): Flash drive containing copies of all final programs utilized within the control panel, with provisions/cable assemblies as required to connect the flash drive provided to the controller to download the programs. Flash drive shall be attached to retractable cord (long enough to reach the associated port) attached to the inside of the panel door.

END OF SECTION 26 29 00

SECTION 26 29 23 – VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This section provides specification requirements for adjustable frequency drives, variable speed drives or herein identified as VFD's.

B. The manufacturer shall modify, field test, adjust and certify all modified VFD's for satisfactory operation.

C. Any exceptions or deviations to this specification shall be indicated in writing and submitted to the engineer for approval a minimum of ten (10) days prior to bid.

1.2 REFERENCES

A. ANSI®/NFPA® 70 - National Electrical Code® (NEC®)

B. CSA® C22.2 No. 14-M91 - Industrial Control Equipment

C. IEC 61000 - Electromagnetic Compatibility

D. NEMA 250 Enclosures for Electrical Equipment

E. NEMA ICS7 - Industrial Control and Systems Adjustable Speed Drives

F. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection Installation and Operation of Adjustable Speed Drives

G. UL® 50 – Enclosures for Electrical Equipment

H. UL 98 – Disconnect Switches

I. UL 507 – Electric Fans

J. UL 508 – Industrial Control Equipment

K. UL 508C – Power Conversion Equipment

L. UL 991 – Safety Tests for Safety Related Controls employing Solid State Devices

M. OSHA® 1910.95 – VFD Controller Acoustical Noise

1.3 QUALITY ASSURANCE

A. All modifications to existing VFDs shall be performed by the original manufacturer of the VFD.

B. The VFD and all associated optional equipment shall be UL Listed according to UL508C Power Conversion Equipment.

C. Quality Assurance documentation shall be furnished to verify successful completion upon written request of the engineer.

1.4 SUBMITTALS

A. Submittals shall be furnished in accordance with Specification Section 26 05 00.

B. Provide the following for each VFD:
1. A job-specific, custom wiring diagram showing final proposal wiring/devices/interconnections/etc.:
   a. The wiring diagram shall clearly show all control components connected to the starter (whether the components are mounted internal or external to the VFD enclosure).
   b. All wires and terminal blocks shall be clearly labeled.
   c. Diagram shall be in accordance with NEMA/ICS standards.
2. Size, type and rating of all system components.
3. Enclosure frontal elevation and dimension drawings.
4. Internal component layout diagrams.
5. Available conduit entry and exit locations.
6. Manufacturer's product data sheets for all components.

C. Standard catalog sheets showing voltage, horsepower, maximum current ratings and recommended replacement parts with part numbers shall be furnished for any new devices/equipment to be provided.

1.5 WARRANTY

A. An 18-month parts warranty (on newly furnished parts) shall be provided on materials and workmanship from the date of owner acceptance/substantial completion after completion of startup.

PART 2 - PRODUCT

2.1 GENERAL DESCRIPTION

A. The existing VFDs shall be field-modified as indicated on plans to allow the remote SCADA system to communicate with the VFDs via hardwired inputs/outputs rather than the existing network interconnections. The existing network interconnections shall be maintained for remote monitoring purposes only (not control).

2.2 CONTROL

A. New input/output module(s), relays, contact blocks, etc. shall be provided as required for the new hardwired input/output points specified.

B. All new I/O shall be wired through properly-labeled terminal blocks within the associated VFD enclosure.

C. All wiring shall be clearly identified on each end to match the wiring diagram(s) provided with the VFD.

D. Refer to Specification Section 26 29 00 (Manufactured Control Panels) as applicable for all operator device and control component requirements (for pushbuttons, indicator lights, selector switches, relays, control wiring, etc).

2.3 COMMUNICATIONS

A. The existing network interconnections to the existing remote SCADA system shall be maintained for remote monitoring purposes only (not control). Where necessary, redundant networked point tags (for these existing networked points) shall include the suffix "_NETWORKED" to clearly delineate between the new hardwired points and the existing networked points.

PART 3 - EXECUTION

3.1 TESTING

A. All incoming material shall be inspected and/or tested for conformance to quality assurance specifications.

B. All subassemblies shall be inspected and/or tested for conformance to quality assurance specifications.

3.2 DELIVERY, STORAGE AND HANDLING

A. Handling and shipment of the equipment shall be in such a manner to prevent internal component damage, breakage, and denting and scoring of the enclosure finish.

B. Equipment shall be stored indoors in a clean, dry environment as directed by the equipment supplier. Energize anti-condensation space heaters if so required.
   1. Verify that the location is ready to receive work and the dimensions are as indicated.
   2. Do not install VFD equipment until the building environment can be maintained within the service conditions required by the manufacturer.

3.3 INSTALLATION

A. Installation shall comply with manufacturer's instructions, drawings and recommendations.

B. A job-specific, custom wiring diagram for each VFD unit shall be provided to the contractor prior to installation for making the appropriate electrical connections. The wiring diagram shall clearly show all control components connected to the VFD (whether the components are mounted internal or external to the VFD enclosure). All wires and terminal blocks shall be clearly labeled. A laminated copy of the final wiring diagram for each unit shall be installed

inside the door of the associated unit.

C. Operations and Maintenance Manuals shall be provided to the owner for all VFD components, control wiring, etc.

D. Operations and Maintenance Manuals shall include hardcopy printouts of all device settings and programming.

E. For safety, reliability, and continuity of warranty, any modifications, alterations, etc. required to conform to the requirements of this specification shall be performed by the VFD manufacturer only. Distributor modifications, third party packaging, etc. of a manufacturer's standard product are specifically disallowed.

3.4 START-UP AND TRAINING

A. The services of a qualified manufacturer's service representative shall be provided to install, test, and start up all VFD's furnished under this specification. The schedule of the startup(s) shall be determined by the contractor.

B. Services shall include a minimum of eight (8) hours of field/classroom training for owner's personnel on routine operation and maintenance of the specified units.

END OF SECTION 26 29 23

SECTION 27 05 00 – AUXILIARY SYSTEM CABLES, 0-50V

PART 1 - GENERAL

1.1 DESCRIPTION

A. Cables rated for 0V-50V application

PART 2 - PRODUCTS

2.1 GENERAL

A. Unless specified otherwise, all cables within the scope of this specification section shall:
   1. Be rated for exposed cable tray installation.
   2. Be plenum rated (Class 1 Control cabling and Instrumentation cabling installed in conduit or exposed in cable tray in non-plenum areas is not required to be plenum-rated).
   3. Be UL-rated for the proposed application.
   4. Be multi-conductor with overall outer sheath as required by the application. The insulation of each conductor within the overall multi-conductor cable shall be uniquely color-coded. Ground conductors (when provided) within the multi-conductor cable shall have green insulation.
   5. Utilize copper conductors.
   6. Have wire gauge as required to limit voltage drop to acceptable limits determined by the system supplier and to meet all applicable code requirements.
   7. Where installed underground, within slab-on-grade or in exterior locations, be rated for wet locations.
   8. Where required for specific systems, meet the specific requirements (conductor quantity, wire gauge, insulation type, shielding, etc.) of the system supplier.

2.2 INSTRUMENTATION CABLING

A. In addition to above requirements, and unless specified otherwise, Instrumentation cabling shall:
   1. Be #16awg minimum.
   2. Be rated for 300V.
   3. Have aluminum foil shielding.
   4. Have stranded, twisted conductors.
   5. Have PVC insulation/jacket with ripcord.
   6. Be manufactured by Belden, AlphaWire or General Cable.

2.3 CLASS 1 CONTROL CABLING (120VAC CONTROL CIRCUITS, ETC.)

A. In addition to above requirements, and unless specified otherwise, Class 1 control cabling shall:
   1. Be rated for 600V.

2. Be industrial grade.
3. Have stranded conductors.
4. Have sunlight/oil-resistant PVC/Nylon insulation and jacket with ripcord.
5. Be manufactured by Belden, AlphaWire or General Cable.

2.4 CLASS 2 & 3 CONTROL CABLING (FED FROM CLASS 2 OR 3 POWER SUPPLIES)

A. In addition to above requirements, and unless specified otherwise, Class 2 & 3 control cabling shall:
1. Be rated for 300V.
2. Be shielded if so recommended by the system supplier/integrator.
3. Have twisted conductors.
4. Have plenum-rated insulation/jacket with ripcord.
5. Be manufactured by AlphaWire, Belden, General Cable, Superior Essex or West Penn.

2.5 NETWORK CABLING

A. Furnish and install all Ethernet, Fiber Optic and Backbone Copper Telephone cabling in accordance with all BICSI requirements and in accordance with other applicable specification sections.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Routing:
1. All wires and cables shall be installed in conduit unless specifically noted otherwise. Where conduit is not otherwise required by contract documents, 0-50V Cabling located within concealed, accessible ceiling spaces (such as above lay-in ceilings) may be run without conduit if the following requirements are met:
   a. Cabling is plenum-rated, multi-conductor.
   b. Cabling is supported by cable tray or with J-hook supports on intervals not to exceed 5’-0” on center. Cabling shall be supported solely from the cable tray or j-hooks supported from the building structure, without using piping, ductwork, conduit or other items as supports.
   c. Cabling is neatly formed, bundled and tied with plenum-rated Velcro straps on intervals not to exceed 30” on center.
   d. Properly-sized conduit(s) are provided wherever cabling enters an inaccessible or exposed area (such as above gyp board ceilings, within walls or through walls).
   e. Cabling is not a part of a Fire Alarm System, Smoke Control System, Emergency Generator Control System or other life-safety related system.
2. End bushings shall be provided on both ends of all raceway terminations.
3. No splices shall be pulled into conduit.
4. No cabling shall be pulled until conduit is cleaned of all foreign matter.

B. Penetrations:

1. All fire/smoke barrier penetrations shall be made in accordance with a U.L. listed assembly.
2. For cabling not installed in conduit:
    a. Fire/smoke barrier penetrations shall be sealed utilizing an enclosed fire-rated pathway device (STI EZ Path or equal) containing a built-in fire sealing system sufficient to maintain the hourly fire rating of the barrier being penetrated. The self-contained sealing system shall automatically adjust to the installed cable loading and shall permit cables to be installed, removed or retrofitted without the need to remove or reinstall firestop materials. The pathway shall be UL Classified and tested to the requirements of applicable ASTM/UL1479 standards.
3. For cabling installed within conduit from endpoint to endpoint:
    a. Fire/smoke barrier penetrations shall sealed utilizing fire caulk or other equivalent firestop systems around perimeters of conduits per UL requirements.
4. For cabling installed within cable trays:
    a. Fire/smoke barrier penetrations shall be sealed with one of the following methods:
        1) Continuous cable tray through the penetration, with a combination of large firestop pillows and small firestop pillows contained, supported and secured (to prevent unauthorized removal) on both sides by aluminum wire mesh and firestop putty. Firestop pillows shall be STI Series SSB or equal and Firestop putty shall be STI Spec Seal or equal.
        2) Cable tray broken at the penetration, with fire/smoke barrier penetrations sealed utilizing an enclosed fire-rated pathway device (STI EZ Path or equal) containing a built-in fire sealing system sufficient to maintain the hourly fire rating of the barrier being penetrated. The self-contained sealing system shall automatically adjust to the installed cable loading and shall permit cables to be installed, removed or retrofitted without the need to remove or reinstall firestop materials. The pathway shall be UL Classified and tested to the requirements of applicable ASTM/UL1479 standards.

C. Excess Cabling:
1. Excess cabling shall be neatly coiled within all junction boxes, pullboxes, wireways, etc. and at all terminations as required to allow future re-termination of cabling.

D. Terminations:
1. Cabling shall be neatly formed, bundled and tied at all terminations.

3.2 SPLICES/CONNECTIONS/TERMINATIONS:

A. Network Cabling:
1. Network and fiber optic cabling shall be continuous from endpoint to endpoint and shall not be spliced unless specifically noted otherwise.

B. Control Cabling:
1. Connections shall be made with T & B Sta-Kon wire joints EPT66M, complete with insulating caps. To be installed with WT161 Tool or C nest of WT11M Tool, Ideal Super - Nuts (not wire nuts), Ideal Wing Nuts, or Buchanan Elec. Products B Cap or Series 2000

Pressure connectors complete with nylon snap on insulators to be installed with C24 pressure tool.

C. Shielded cabling:
   1. Unless directed otherwise by the system supplier, 0-50V cable shielding shall be grounded at the PLC/control panel end only (not at the field device end) with a termination kit as directed by the PLC/control panel supplier.
   2. Shielded cabling shall be continuous from endpoint to endpoint and shall not be spliced without prior written approval from the Engineer.

3.3 LABELING

A. Refer to Specification Section 26 05 53 for all labeling requirements.

END OF SECTION 27 05 00

SECTION 27 60 00 – SCADA SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work included: Provide modifications for a complete SCADA System with appurtenant equipment and accessories as indicated, specified, and as necessary for a complete and proper operating system.
   1. Work includes, but not necessarily limited to, the following:
      a. New RTU-1E and all modifications to existing RTUs and other appurtenances as indicated and specified herein and as required.
      b. All engineering, hardware and software development, installation, startup, calibration services and supervision necessary.
      c. Testing and operational demonstrations as specified.
      d. Training programs as specified.
      e. Preparation of manuals.
      f. Maintenance of existing SCADA HMI package, and programming as required to monitor relocated/replaced RTU points via existing HMI.

B. Related work:
   1. Documents affecting work of this Section include, but are not necessarily limited to, General Specifications, Special Provisions, and all other related Sections.
   2. Refer to Specification Section 26 29 00 for additional control panel requirements.
   3. Refer to plans for point lists and other additional requirements.

1.2 QUALITY ASSURANCE

A. All SCADA System Integrators proposing to bid on the project shall visit the project site prior to bid to determine and verify existing conditions affecting SCADA System Integration work, including types/manufacturers/models of existing equipment/devices, types/quantities of existing SCADA HMI screens, types/quantities of existing points, availability of spare I/O provisions, etc.. Bid price shall include all work, equipment, labor, interconnections, etc. for a fully functional final system.

B. The qualifications and experience of key project personnel shall be acceptable to the Engineer. The System Integrator shall employ competent service personnel to service and troubleshoot the control and instrumentation systems and shall have at least 15 years of experience with similar work. References shall be provided upon request by the Engineer. The System Integrator shall maintain their own UL508 panel shop. The geographic location of a fully staffed office with Engineers, Service Personnel, and programmers shall be within a150 mile radius of the project site. The System Integrators approved for this project are:
   1. Troy Systems Integration Group (TSIG) – Madison, Alabama
   2. Revere Control Systems, Inc. - Birmingham, Alabama
   3. M/R Systems, Inc. – Norcross, Georgia

C. The system integration duties shall be provided by a company qualified, experienced, and regularly engaged in designing, setting up, programming, and integrating complex process loop controls and instrumentation for process control and monitoring applications. Only qualified system integrators will be allowed to submit proposals for this project. In order to be considered qualified, integrator shall have completed a minimum of five (5) projects of similar type/scope and equal or greater magnitude and complexity within the last ten (10) years. Sub-contractors without qualifications will be rejected. If desired, potential electrical sub-contractors may submit qualification evidence for review and pre-bid approval a minimum of ten (10) days prior to bid. Previous projects used to meet this experience requirement must have included similar (or greater) scopes of work for each of the following areas:

1. Process loop controls for the proposed processes
2. HMI graphics
3. Instrumentation
4. Control Panel/PLC panel construction

D. The System Integrator shall have and shall maintain a qualified technical and support staff. The System Integrator shall employ a professional Control Systems Engineer or Electrical Engineer registered in Alabama to supervise or perform the work required by this Specification. The SI shall employ service personnel on this project who have successfully completed ISA certification Level 1 or higher and manufacturer's training courses on general process instrumentation and configuration and implementation of the specific process controllers and software proposed for this project.

E. Contractor:

1. Shall be fully and solely responsible for the work of the systems supplier and solely responsible to the Owner for having supplied to the Owner the complete integrated SCADA system.
2. To provide personal superintendence and direction of the work, maintaining and supplying complete supervision over and coordination between all subcontractors employed by him and the Instrumentation and Control System Integrator.
3. To be responsible for defining the limits of his subcontractor's work.

F. Operation and Maintenance Manuals

1. Operating instructions shall incorporate a functional description of the entire system, including the system schematics which reflect “as-built” modifications.
2. Special maintenance requirements particular to the system shall be clearly defined along with special calibration and test procedures.
3. As part of the operation and maintenance manuals, provide one hard copy of the program used to program the programmable logic controller.

1.3 WARRANTY

A. Systems supplier shall furnish a hardware and software warranty for the system starting at substantial completion and ending one year from this date.

1.4 REFERENCES

A. Instrument Society of America (ISA) PR7. 1, Pneumatic Control Circuit Pressure Test, Tentative Recommendation Practice.

B. Instrument Society of America (ISA) S5.4, Instrument Loop Diagrams, standard.

C. National Electrical Manufacturers Association (NEMA) Publication, General Standards for Industrial and Control Systems, ICS 1 and Industrial Controls and Systems ICS2.

1.5 SUBMITTALS

A. General/System submittal requirements:
   1. Provide submittal (quantity as required by contract) of:
      a. Component manufacturing data sheets indicating pertinent data and identifying each component (including all components within RTU/control panel enclosures, instruments, surge protection devices, Ethernet switches, etc.) by tag number and nomenclature as indicated on drawings and in specifications.
      b. Component drawing showing dimensions, mounting, and external connection details,
      c. List of all spare parts. All manufacturers recommended spare parts shall be provided in addition to required spare parts.
      d. Shop test plan and results.
   2. Identify any specification section where exceptions are being taken or an "or equal" piece of hardware is being proposed.
   3. A Bill of Materials shall be included with catalog information on all components.
   4. Information shall be included on any proprietary logic component sufficient to demonstrate its ability to perform the required functions.

B. Panel submittal requirements:
   1. A job-specific, custom wiring diagram
      a. The wiring diagram shall clearly show all new components (whether the components are mounted internal or external to the control panel enclosure).
      b. All wires and terminal blocks shall be clearly labeled.
      c. Diagram shall be in accordance with NEMA/ICS standards.
      d. All new numbering, labeling, etc. shall be coordinated with existing schemes to provide a consistent final numbering/labeling system.
   2. Size, type and rating of all new system components.
   3. Unit frontal elevation and dimension drawings.
   4. Internal component layout diagrams.
   5. Manufacturer’s product data sheets for all components.

1.6 DELIVERY, STORAGE AND HANDLING:

A. Packing and Labeling:

1. Prior to shipment, each component shall be tagged to identify its' location, tag number, and system function. Identification shall be prominently displayed on the outside of the package.
2. Firmly attach permanent, final labeling (as specified elsewhere) to all equipment, panels, instruments/field devices, etc. prior to installation.

B. Delivery:
1. Following completion of shop assembly, factory test, and approval of all equipment by the Engineer, the panels, cabinets, and consoles and equipment shall be shipped. Provide protection for equipment from handling and the environment.

C. Receiving:
1. The contractor is responsible for receiving and proper storage of equipment delivered to the job site.
2. All received items shall be protected from the elements and where required stored in a low humidity environment.
3. Protect materials and equipment against damage in storage and during construction.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Refer to Specification Section 26 29 00 (Manufactured Control Panels) for all control panel enclosure, control component, controller, surge protection device, etc. requirements.

B. Specifications below identify general intent and major system components only. System Integrator shall be responsible providing all system accessories, interconnections, installation, etc. and verifying compatibility of all system components as required to provide a fully-functional/coordinated system.

2.2 SCADA COMPUTER SYSTEMS

A. General:
1. SCADA Computer systems (including workstations, servers, printers, and other similar items) are existing and shall be modified only as required by the addition of the new RTU, and associated relocation/remapping of I/O.

2.3 REMOTE TERMINAL UNITS (RTU'S)

A. General:
1. SCADA Integrator shall be responsible for providing all equipment/devices/ programming/etc. as required for a complete system. No equipment/devices will be owner-furnished.

B. New RTU-1E shall include:

1. General construction/materials/devices per Specification Section 26 29 00 (Manufactured Control Panels).
2. Controller, Power Supply, and I/O Devices:
   a. The RTU shall include a Modicon Quantum Unity Pro Hot Standby System, complete with the following:
      1) Primary Rack:
         a) Slot 1: Modicon CPS 124 20 Power Supply Module (primary power supply)
         b) Slots 2/3: Modicon CPU 672 61 Processor CPU Module
         c) Slots 4/5: Modicon Remote Ethernet I/O and Network Interface Modules as required for Hot Standby System operation and as required for Ethernet connection to existing SCADA system (via dedicated Cat6 cable to existing local Main Ethernet Switch).
         d) Slot 6: Modicon CPS 124 20 Power Supply Module (redundant power supply)
      2) Standby Rack:
         a) Slot 1: Modicon CPS 124 20 Power Supply Module (primary power supply)
         b) Slots 2/3: Modicon CPU 672 61 Processor CPU Module
         c) Slots 4/5: Modicon Remote Ethernet I/O and Network Interface Modules as required for Hot Standby System operation and as required for Ethernet connection to existing SCADA system (via dedicated Cat6 cable to existing local Main Ethernet Switch).
         d) Slot 6: Modicon CPS 124 20 Power Supply Module (redundant power supply)
      3) Ethernet I/O Rack:
         a) Slot 1: Modicon CPS 124 20 Power Supply Module (primary power supply)
         b) Slot 2: Modicon CRA 312 00 Remote Ethernet I/O Communications Module
         c) Slots 3-15: Modicon Quantum I/O Modules as required by point lists provided on plans. Spare I/O: A quantity of spare I/O equal to 25% of the quantity included in the PLC of each I/O point type or two of each I/O point type (whichever is greater) shall be provided for each PLC. For example, a PLC with 20 Discrete Inputs, 2 Discrete Outputs and 4 Analog Outputs shall be provided with 25 Discrete Inputs, 3 Discrete Outputs, 5 Analog Inputs and 2 Analog Outputs (including spares). This applies to the following I/O point types:
            (1) Discrete Input
            (2) Discrete Output
            (3) Analog Input
            (4) Analog Output
         d) Slot 16: Modicon CPS 124 20 Power Supply Module (redundant power supply)
   b. Provide additional network/communication modules (for Ethernet, Profibus, DeviceNet, etc. connections) as required to communicate with existing SCADA network infrastructure and as additionally required for new network-connected points per lists provided on plans. All networked points listed are representative only. Prior to preparation of submittals, System Integrator shall collect register lists

identifying all available networked points for the associated systems from the system supplier(s) and shall review the lists with the owner and engineer for determination of final points to be monitored/controlled. System Integrator shall provide programming/HMI for all networked points chosen by the owner/engineer for these systems.

3. Touchscreen:
   a. None Required.
4. Flash-Drive Programming Backup:
   a. Provide portable USB-type flash-drive mounted to retractable cord hung from inside surface of inner door downloaded with final copies of all programming, etc. for equipment within panel (controller, touchscreen, etc.). Provide engraved nameplate to read: “PROGRAMMING BACKUP”.
5. UPS: Liebert PSA series with surge protection, USB communication and shutdown software. Enough battery-supplied power shall be provided to operate the system for at one (1) hour. The uninterruptible power source shall utilize low maintenance, rechargeable, sealed batteries, maintained at a float charge during normal sealed conditions. The UPS shall output a synchronized 60 Hz. sine-wave output, in phase with the commercial line power sine-wave. The sine-wave output shall be synchronized during switching from commercial AC power source to battery source and during switching from battery source back to commercial AC power source. The UPS shall switch to and from battery in less than 4 milliseconds. The UPS shall visually indicate its current mode of operation. The UPS shall provide visible alarms indicating commercial AC line power failure and low battery. The UPS shall be connected through relaying such that it will by bypassed in the event of a UPS failure.
6. 20A-120V-1Pole grounding-type GFI receptacle within inner door of panel for convenience (laptop charging, etc.). Receptacle shall be connected upstream of UPS power and shall be protected by a dedicated circuit breaker rated for 10A.
7. Panel surge protection, lighting, HVAC, auxiliary components, etc. shall be provided per Specification Section 26 29 00.

2.4 WIRING

A. Refer to Specification Section 26 29 00 for requirements.

PART 3 - EXECUTION

3.1 GENERAL

A. SCADA System shall:
   1. Reuse existing SCADA HMI software package for the relocated/repurposed I/O points. Modified system shall continue to display/trend/historize/alarm/etc. to match the existing system.
   2. Where possible, utilize typical/template SCADA function blocks (to be furnished to SCADA Integrator by owner within construction phase of project) in order to provide finished system programming consistent with County standards. SCADA Integrator shall

modify owner-furnished function blocks as required to provide the required functionality.

3. Include new RTU to:
    a. Measure and monitor discrete and continuous process and process equipment variables (see SCADA Point List on contract plans).
    b. Provide local process control (within the RTU) for the relocated points (per point lists) as required to match the existing process control loops at the facility.

3.2 TESTING

A. General
1. All elements of the hardware and software shall be tested to demonstrate that the total system satisfies all of the requirements of this specification.
2. As a minimum the testing shall include the following:
    a. Operational Readiness Test (ORT) for EACH pump VFD (each VFD is to be migrated from the old RTU controls to the new controls one at a time to ensure reliable operation of the remainder of the pumps during the testing phase).
    b. Functional Acceptance Test (FAT) for EACH pump VFD (each VFD is to be migrated from the old RTU controls to the new controls one at a time to ensure reliable operation of the remainder of the pumps during the testing phase).
3. Each test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and upon the system's or subsection's producing the correct result (effect), the specific test requirement will have been satisfied.

B. Operational Readiness Test (ORT)
1. General: Prior to start-up, the installed System shall be certified (inspected, tested and documented) that it is ready for operation. These inspections and tests shall include Loop/Component Inspections and Tests and a repeat of the Factory Demonstration Tests.

C. Functional Acceptance Test (FAT)
1. The SCADA System shall be tested on-site to demonstrate that it is operational and in conformance with these specifications.
2. Tests shall demonstrate specified functions, both hardware and software, to the satisfaction of the owner.

3.3 TRAINING

A. General
1. Provide an integrated training program for the owner's personnel at the jobsite. Tailor the training program to meet the specific needs of the Owner's personnel. Include training sessions, classroom and field, for managers, engineers, operators and maintenance personnel.
2. The training shall be carried out by technically competent and experienced instructors
3. The Owner shall have the right to make and reuse video tapes of all of the onsite training sessions.

END OF SECTION 27 60 00

JEFFERSON COUNTY ENVIRONMENTAL SERVICES DEPARTMENT
JEFFERSON COUNTY, ALABAMA

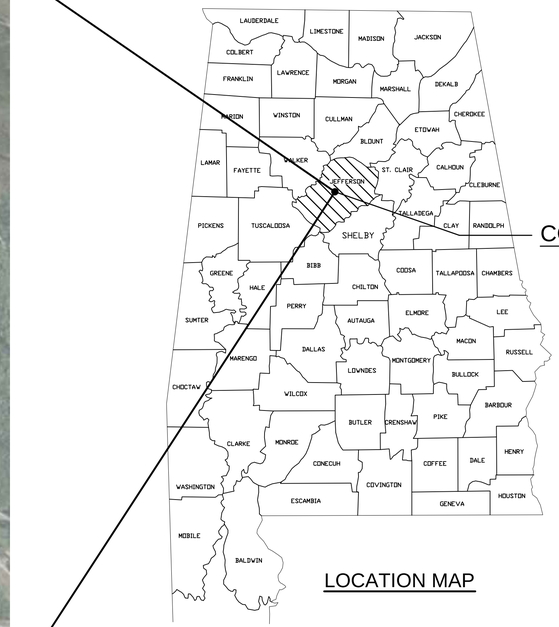
PLANS FOR

INFLUENT PUMP CONTROL MODIFICATIONS
FIVE MILE WWTP

JRA PROJECT No. 214114

MARCH 13, 2015

VICINITY MAP



LOCATION MAP

INDEX OF DRAWINGS

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3-13-2015

INFLUENT PUMP CONTROL MODIFICATIONS
FIVE MILE WWTP
JEFFERSON COUNTY ENVIRONMENTAL SERVICES DEPARTMENT
JEFFERSON COUNTY, AL

DESIGNED	PROJECT NUMBER
PDB	214114
DRAWN: DRA	
CHECKED: PDB	

REVISIONS

NO.	DATE	DESCRIPTION

SHEET TITLE: COVER SHEET

ISSUE DATE	SHEET NO.
03/13/2015	E0-00
SEQUENCE: 1 OF 4	

NEW/MODIFIED SCADA POINT LIST AND CONTROL & INSTRUMENTATION WIRING SCHEDULE

HOMERUN MARK	FROM	TO	EQUIP. ID NO.	EQUIPMENT DESCRIPTION	PARAMETER	POINT TYPE	TAG	WIRING	SHEET	REMARKS
SC-FIT0001	EX RTU-1A	RTU-1E	FIT0001	INFLENT FLOW METER	FLOW INDICATION	AI	INFLUENT_FLOW	(6) #16TSP - 1 1/2"C	E1-02	SEE NOTE 6
			PIT1013	INFLUENT PUMP NO. 1 PRESSURE TRANSMITTER	PRESSURE INDICATION	AI	INFLUENT_PUMP_1_PRESSURE			SEE NOTE 6
			PIT1014	INFLUENT PUMP NO. 2 PRESSURE TRANSMITTER	PRESSURE INDICATION	AI	INFLUENT_PUMP_2_PRESSURE			SEE NOTE 6
			PIT1015	INFLUENT PUMP NO. 3 PRESSURE TRANSMITTER	PRESSURE INDICATION	AI	INFLUENT_PUMP_3_PRESSURE			SEE NOTE 6
			PIT1017	INFLUENT PUMP NO. 5 PRESSURE TRANSMITTER	PRESSURE INDICATION	AI	INFLUENT_PUMP_5_PRESSURE			SEE NOTE 6
			PIT1018	INFLUENT PUMP NO. 6 PRESSURE TRANSMITTER	PRESSURE INDICATION	AI	INFLUENT_PUMP_6_PRESSURE			SEE NOTE 6
SC-LIT0101A	EX LIT0101A	RTU-1E	LIT0101A	INFLUENT WET WELL LEVEL TRANSMITTER A	LEVEL INDICATION	AI	INFLUENT_WET_WELL_A_LEVEL_HARDWIRED	(1) #16TSP &	E1-01	SEE NOTE 7
	EX LIT0101A	EX RTU-1A	LIT0101A	INFLUENT WET WELL LEVEL TRANSMITTER A	LEVEL INDICATION	EN- AI	INFLUENT_WET_WELL_A_LEVEL_NETWORKED	(1) CAT6 ETHERNET CABLE - 1"C	E1-01	SEE NOTE 8
SC-LIT0101B	EX LIT0101B	RTU-1E	LIT0101B	INFLUENT WET WELL LEVEL TRANSMITTER B	LEVEL INDICATION	AI	INFLUENT_WET_WELL_B_LEVEL_HARDWIRED	(1) #16TSP &	E1-01	SEE NOTE 7
	EX LIT0101B	EX RTU-1B	LIT0101B	INFLUENT WET WELL LEVEL TRANSMITTER B	LEVEL INDICATION	EN- AI	INFLUENT_WET_WELL_B_LEVEL_NETWORKED	(1) CAT6 ETHERNET CABLE - 1"C	E1-01	SEE NOTE 8
SC-M1013	EX M1013 VFD	RTU-1E	M1013	INFLUENT PUMP NO. 1 (M1013) VFD	ON/OFF CONTROL	DO	INFLUENT_PUMP_1_CALL_TO_RUN	(1) 16C#14 - 1"C AND	E1-02	SEE NOTE 4
					VFD ON/OFF STATUS	DI	INFLUENT_PUMP_1_VFD_RUN_CONFIRM	(3) #16TSP - 1 1/4"C		
					SPEED CONTROL	AO	INFLUENT_PUMP_1_SPEED_CONTROL			
					SPEED INDICATION	AI	INFLUENT_PUMP_1_SPEED_STATUS			
					SHUTDOWN ALARM	DI	INFLUENT_PUMP_1_ALARM			
					WARNING ALARM	DI	INFLUENT_PUMP_1_WARNING			
					ALARM RESET	DO	INFLUENT_PUMP_1_ALARM_RESET			
					LOCAL/REMOTE SWITCH POSITION INDICATION	DI	INFLUENT_PUMP_1_SET_REMOTE			
					BYPASS STARTER SWITCH POSITION INDICATION	DI	INFLUENT_PUMP_1_SET_BYPASS			
					BYPASS STARTER ON/OFF STATUS	DI	INFLUENT_PUMP_1_BYPASS_RUN_CONFIRM			
					CURRENT (AMPERAGE) INDICATION - 3 PHASE AVG.	AI	INFLUENT_PUMP_1_CURRENT			
SC-M1014	EX M1014 VFD	RTU-1E	M1014	INFLUENT PUMP NO. 2 (M1014) VFD	ON/OFF CONTROL	DO	INFLUENT_PUMP_2_CALL_TO_RUN	(1) 12C#14 - 1"C AND	E1-02	SEE NOTE 4
					ON/OFF STATUS	DI	INFLUENT_PUMP_2_RUN_CONFIRM	(3) #16TSP - 1 1/4"C		
					SPEED CONTROL	AO	INFLUENT_PUMP_2_SPEED_CONTROL			
					SPEED INDICATION	AI	INFLUENT_PUMP_2_SPEED_STATUS			
					SHUTDOWN ALARM	DI	INFLUENT_PUMP_2_ALARM			
					WARNING ALARM	DI	INFLUENT_PUMP_2_WARNING			
					ALARM RESET	DO	INFLUENT_PUMP_2_ALARM_RESET			
					LOCAL/REMOTE SWITCH POSITION INDICATION	DI	INFLUENT_PUMP_2_SET_REMOTE			
					CURRENT (AMPERAGE) INDICATION - 3 PHASE AVG.	AI	INFLUENT_PUMP_2_CURRENT			
SC-M1015	EX M1015 VFD	RTU-1E	M1015	INFLUENT PUMP NO. 3 (M1015) VFD	ON/OFF CONTROL	DO	INFLUENT_PUMP_3_CALL_TO_RUN	(1) 12C#14 - 1"C AND	E1-02	SEE NOTE 4
					ON/OFF STATUS	DI	INFLUENT_PUMP_3_RUN_CONFIRM	(3) #16TSP - 1 1/4"C		
					SPEED CONTROL	AO	INFLUENT_PUMP_3_SPEED_CONTROL			
					SPEED INDICATION	AI	INFLUENT_PUMP_3_SPEED_STATUS			
					SHUTDOWN ALARM	DI	INFLUENT_PUMP_3_ALARM			
					WARNING ALARM	DI	INFLUENT_PUMP_3_WARNING			
					ALARM RESET	DO	INFLUENT_PUMP_3_ALARM_RESET			
					LOCAL/REMOTE SWITCH POSITION INDICATION	DI	INFLUENT_PUMP_3_SET_REMOTE			
					CURRENT (AMPERAGE) INDICATION - 3 PHASE AVG.	AI	INFLUENT_PUMP_3_CURRENT			
SC-M1017	EX M1017 VFD	RTU-1E	M1017	INFLUENT PUMP NO. 5 (M1017) VFD	ON/OFF CONTROL	DO	INFLUENT_PUMP_5_CALL_TO_RUN	(1) 16C#14 - 1"C AND	E1-02	SEE NOTE 4
					VFD ON/OFF STATUS	DI	INFLUENT_PUMP_5_VFD_RUN_CONFIRM	(3) #16TSP - 1 1/4"C		
					SPEED CONTROL	AO	INFLUENT_PUMP_5_SPEED_CONTROL			
					SPEED INDICATION	AI	INFLUENT_PUMP_5_SPEED_STATUS			
					SHUTDOWN ALARM	DI	INFLUENT_PUMP_5_ALARM			
					WARNING ALARM	DI	INFLUENT_PUMP_5_WARNING			
					ALARM RESET	DO	INFLUENT_PUMP_5_ALARM_RESET			
					LOCAL/REMOTE SWITCH POSITION INDICATION	DI	INFLUENT_PUMP_5_SET_REMOTE			
					BYPASS STARTER SWITCH POSITION INDICATION	DI	INFLUENT_PUMP_5_SET_BYPASS			
					BYPASS STARTER ON/OFF STATUS	DI	INFLUENT_PUMP_5_BYPASS_RUN_CONFIRM			
					CURRENT (AMPERAGE) INDICATION - 3 PHASE AVG.	AI	INFLUENT_PUMP_5_CURRENT			
SC-M1018	EX M1018 VFD	RTU-1E	M1018	INFLUENT PUMP NO. 6 (M1018) VFD	ON/OFF CONTROL	DO	INFLUENT_PUMP_6_CALL_TO_RUN	(1) 12C#14 - 1"C AND	E1-02	SEE NOTE 4
					ON/OFF STATUS	DI	INFLUENT_PUMP_6_RUN_CONFIRM	(3) #16TSP - 1 1/4"C		
					SPEED CONTROL	AO	INFLUENT_PUMP_6_SPEED_CONTROL			
					SPEED INDICATION	AI	INFLUENT_PUMP_6_SPEED_STATUS			
					SHUTDOWN ALARM	DI	INFLUENT_PUMP_6_ALARM			
					WARNING ALARM	DI	INFLUENT_PUMP_6_WARNING			
					ALARM RESET	DO	INFLUENT_PUMP_6_ALARM_RESET			
					LOCAL/REMOTE SWITCH POSITION INDICATION	DI	INFLUENT_PUMP_6_SET_REMOTE			
					CURRENT (AMPERAGE) INDICATION - 3 PHASE AVG.	AI	INFLUENT_PUMP_6_CURRENT			

CONTROL & INSTRUMENTATION WIRING SCHEDULES LEGEND & NOTES

LEGEND:

"DI" - DISCRETE INPUT POINT
"DO" - DISCRETE OUTPUT POINT
"AI" - ANALOG INPUT POINT
"AO" - ANALOG OUTPUT POINT

NOTES:

1. SEE SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS & INFORMATION.
2. ALL CONTROL CABLING (IDENTIFIED WITH "*C#14" OR SIMILAR DESIGNATIONS) SHALL BE 600V MULTI-CONDUCTOR TRAY CABLE PER SPECIFICATION REQUIREMENTS.
3. ALL INSTRUMENTATION CABLING (IDENTIFIED WITH "TSP" OR "SHD" DESIGNATIONS) SHALL BE 300V TWISTED, OVERALL-SHIELDED TRAY CABLE.
4. EXISTING NETWORK CABLING/COMMUNICATIONS FROM EXISTING INFLUENT PUMP STARTERS (NOT SHOWN) TO EXISTING SCADA RTU'S SHALL BE MAINTAINED FOR MONITORING ONLY (NOT CONTROL).
5. EXISTING HARDWIRED INFLUENT PUMP VIBRATION MONITORING SHALL BE MAINTAINED AT EXISTING RTU'S.
6. INDICATED POINTS ARE EXISTING HARDWIRED POINTS AT EXISTING RTU'S THAT SHALL BE RECONNECTED TO NEW I/O MODULES IN NEW RTU-1E. EXTEND & RECONNECT EXISTING INSTRUMENTATION CABLING AS REQUIRED.
7. INDICATED NEW HARDWIRED POINTS TO NEW RTU-1E SHALL REPLACE EXISTING NETWORKED MONITORING FOR SAME POINTS IN EXISTING RTU'S.
8. INDICATED POINTS ARE EXISTING NETWORK POINTS AT EXISTING RTU'S THAT SHALL BE MAINTAINED (BUT WITH NEW TAG ID'S AS INDICATED). EXISTING NETWORK CABLING TO EXISTING INSTRUMENT SHALL REPLACED IN NEW CONDUIT AS SHOWN.

GENERAL ELECTRICAL LEGEND

F/O — FIBER OPTIC CABLING – INSTALLED IN CABLE TRAY OR CONDUIT SIZE AS REQUIRED.

BRANCH/FEEDER CIRCUIT – EXPOSED ON WALLS OR CEILING.

BRANCH/FEEDER CIRCUIT – TO BE DEMOLISHED – MAY BE USED WITH OTHER LINE TYPES.

BRANCH/FEEDER CIRCUIT – HOMERUN 2 #12 & 1 #12G, 3 #12 & 1 #12G, ETC. UNLESS SHOWN OTHERWISE.

FLEXIBLE CONNECTION TO EQUIPMENT.

DISTRIBUTION CENTER OR MOTOR CONTROL CENTER.

LIGHTING PANEL – SURFACE MOUNTED.

LIT — LEVEL INDICATING TRANSMITTER.

SC-**** — TYPICAL CONTROL & INSTRUMENTATION WIRING MARK (WHERE "**" REPRESENTS A UNIQUE IDENTIFIER CONSISTING OF LETTERS AND NUMBERS) – SEE CONTROL & INSTRUMENTATION WIRING SCHEDULES.

GENERAL ABBREVIATIONS:

EX	EXISTING TO REMAIN.
EX-R	EXISTING TO BE REMOVED – REMOVE ALL ASSOCIATED ELECTRICAL EQUIPMENT, DEVICES, CONDUIT AND WIRING CONNECTIONS TO OTHER ELECTRICAL ITEMS UNLESS SHOWN OTHERWISE.
EX-RL	EXISTING TO BE RELOCATED – REMOVE ALL ASSOCIATED ELECTRICAL EQUIPMENT, DEVICES, CONDUIT AND WIRING AT EXISTING LOCATION. RELOCATE ITEM TO NEW LOCATION SHOWN ON ELECTRICAL PLANS. EXTEND AND RECONNECT EXISTING CONDUIT, WIRING, ETC. TO NEW LOCATION AS REQUIRED UNLESS SHOWN OTHERWISE.
EX-RP	EXISTING TO BE REPLACED – EXTEND AND RECONNECT EXISTING CONDUIT AND WIRING TO REPLACED ITEM.

ELECTRICAL ABBREVIATIONS:

C	CONDUIT.
E.C.	EMPTY CONDUIT.
FPN	FUSE PER NAMEPLATE.
G	GROUND CONDUCTOR.

MULTI-CONDUCTOR CONTROL 600V TRAY CABLE DESIGNATIONS:

(2) 4C#14 W/G – 1 1/4"C
- CONDUIT SIZE.
- "W/G" = WITH ADDITIONAL INTEGRAL GROUND CONDUCTOR WITH GREEN INSULATION IN EACH CABLE SHEATH.
- WIRE GAUGE.
- QUANTITY OF CONDUCTORS IN EACH CABLE SHEATH (NOT INCLUDING GROUND).
- QUANTITY OF MULTI-CONDUCTOR CABLES OF THE TYPE SPECIFIED WITHIN THE SPECIFIED CONDUIT.

TWISTED, SHIELDED INSTRUMENTATION CABLE DESIGNATIONS:

(2) #16TSP – 1"C
- CONDUIT SIZE.
- "TSP" = TWISTED SHIELDED PAIR.
- WIRE GAUGE.
- QUANTITY OF INSTRUMENTATION CABLES IN THE SPECIFIED CONDUIT.

GENERAL ELECTRICAL NOTES

1. ALL EQUIPMENT SHALL BE GROUNDED AND BONDED IN ACCORDANCE WITH NEC.
2. CONTRACTOR SHALL VISIT THE SITE OF THE WORK PRIOR TO SUBMITTING BID TO EXAMINE CAREFULLY LOCAL CONDITIONS AND DIFFICULTIES TO BE ENCOUNTERED. ANY DISCREPANCY BETWEEN PLANS AND EXISTING CONDITIONS SHALL IMMEDIATELY BE CALLED TO THE ATTENTION OF THE ENGINEER.
3. REMOVE ALL EXISTING ELECTRICAL EQUIPMENT AND WIRING MADE OBSOLETE BY THIS RENOVATION AND DISPOSE OF AS DIRECTED BY THE ENGINEER.
4. EXISTING PANEL DIRECTORY CARDS MODIFIED BY THIS RENOVATION SHALL BE RETYPED TO INDICATE CONNECTED CIRCUITS.
5. THIS CONTRACTOR SHALL FURNISH ALL MATERIALS AND LABOR NECESSARY TO EXTEND CIRCUITS AND MAKE RECONNECTIONS TO ANY ACTIVE ELECTRICAL DEVICES ON WHICH THE BRANCH CIRCUIT IS INTERRUPTED BY THIS ALTERATION. CARE SHALL BE TAKEN TO INSURE THAT EXISTING PANEL AND FEEDER RATINGS ARE NOT EXCEEDED.
6. SPECIAL ATTENTION IS CALLED TO THE FACT THAT THIS IS AN OPERATING SYSTEM, AND AS SUCH, NO UNNECESSARY SHUTDOWNS WILL BE ALLOWED. ANY NECESSARY SHUTDOWNS SHALL BE APPROVED IN WRITING BY THE PLANT MANAGER A MINIMUM OF TWO (2) WEEKS IN ADVANCE.
7. THE ELECTRICAL DEMOLITION PLANS INDICATE GENERAL SCOPE OF DEMOLITION WORK TO BE ACCOMPLISHED UNDER THIS CONTRACT. IT IS NOT THE INTENT OF THESE PLANS TO DETAIL ALL ELECTRICAL ITEMS THAT MUST BE REMOVED. THE ELECTRICAL CONTRACTOR SHALL REFER TO ALL OTHER DEMOLITION PLANS IN THIS SET OF DRAWINGS FOR ADDITIONAL INFORMATION RELATED TO EXTENT AND SCOPE OF DEMOLITION WORK. REFER TO ELECTRICAL SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS. VERIFY ALL REQUIREMENTS AT JOB SITE PRIOR TO BID.
8. EXISTING SALVAGEABLE MATERIALS REMOVED SHALL REMAIN THE PROPERTY OF THE OWNER AND SHALL BE DELIVERED TO OWNER'S DESIGNATED STORAGE FACILITY. ANY MATERIALS REMOVED THAT THE OWNER DOES NOT WISH TO RETAIN SHALL BE DISPOSED OF BY THE CONTRACTOR.
9. NO EXISTING ELECTRICAL ITEMS SHALL BE REMOVED WITHOUT PRIOR WRITTEN CONSENT OF THE OWNER. THE EXISTING FACILITIES SHALL BE KEPT OPERATIONAL THROUGHOUT THE CONSTRUCTION PROCESS UNTIL THE NEW FACILITIES ARE IN SERVICE.
10. ALL EXISTING ELECTRICAL EQUIPMENT, CONDUIT, WIRING, DEVICES, ETC. THAT BECOME OBSOLETE WITHIN THIS PROJECT SHALL BE DEMOLISHED COMPLETELY (OTHER ITEMS SHALL REMAIN IN SERVICE).

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ALABAMA LICENSED No. 27420 PROFESSIONAL ENGINEER PHILIP D. BLACK
3-13-2015

INFLUENT PUMP CONTROL MODIFICATIONS
FIVE MILE WWTP
JEFFERSON COUNTY ENVIRONMENTAL SERVICES DEPARTMENT
JEFFERSON COUNTY, AL

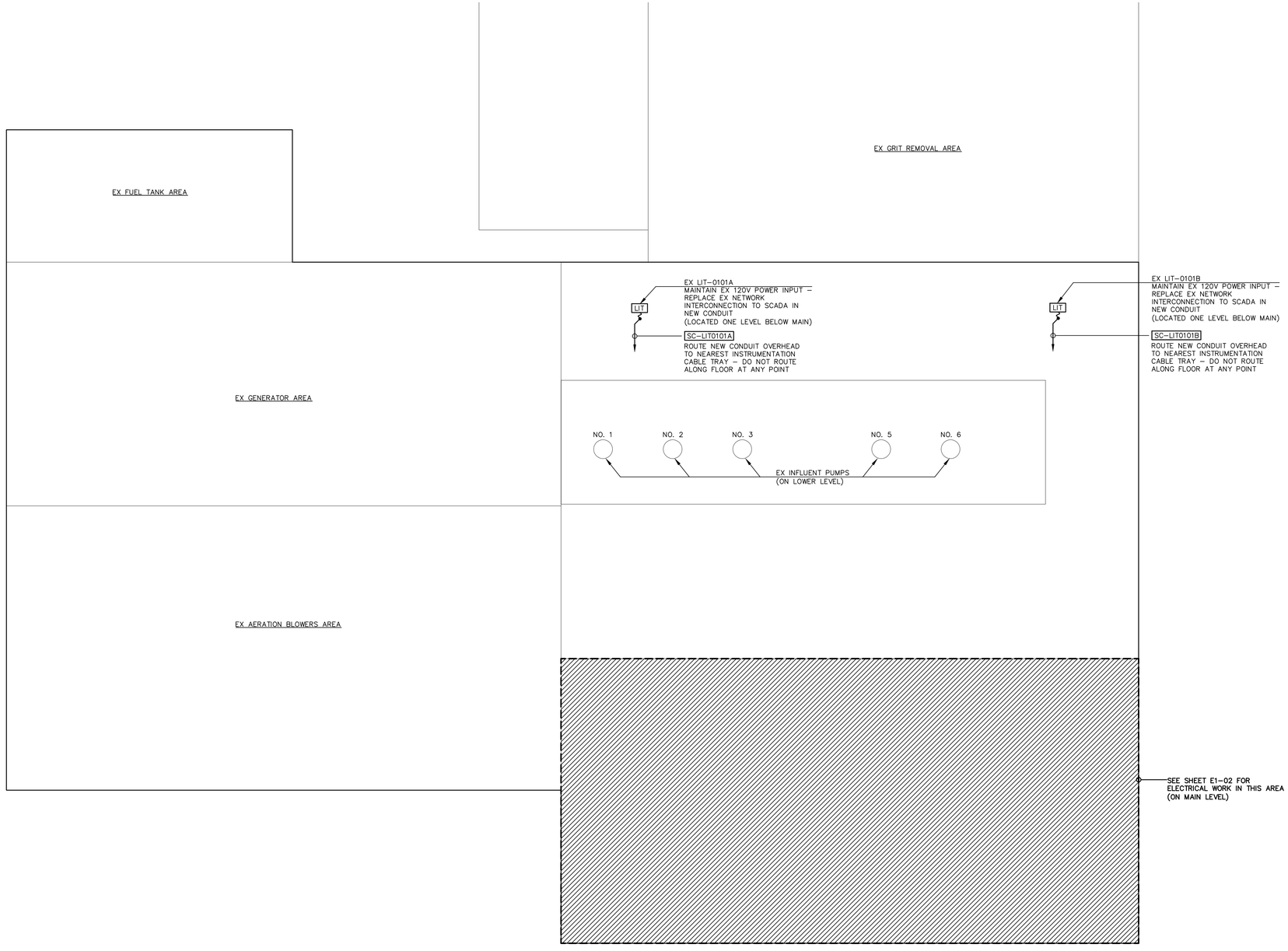
DESIGNED PDB	PROJECT NUMBER 214114
DRAWN DRA	
CHECKED PDB	

REVISIONS

NO.	DATE	DESCRIPTION

SHEET TITLE
ELECTRICAL LEGEND, NOTES AND SCHEDULE

ISSUE DATE	SHEET NO.
03/13/2015	E0-01
SEQUENCE 2 OF 4	



INFLUENT PUMP STATION OVERALL ELECTRICAL PLAN

APPROXIMATE SCALE : 1/8" = 1'-0"

PLAN NOTES
1. CONTRACTOR SHALL REUSE EXISTING CABLE TRAY FOR NEW CABLING WHERE POSSIBLE.

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INFLUENT PUMP STATION OVERALL ELECTRICAL PLAN

ISSUE DATE	SHEET NO.
03/13/2015	E1-01
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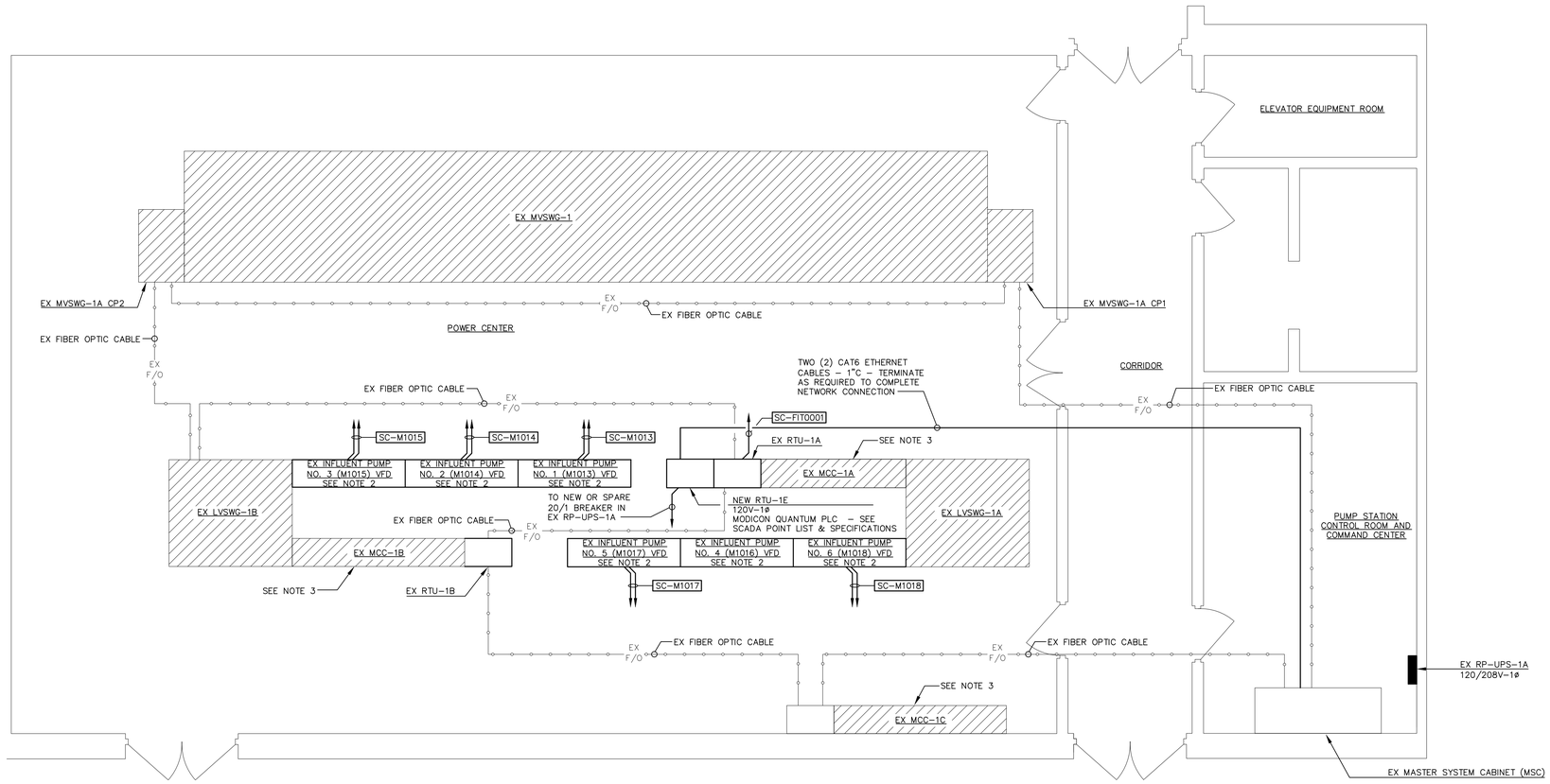

INFLUENT PUMP STATION ELECTRICAL AREA ELECTRICAL PLAN

APPROXIMATE SCALE : 1/4" = 1'-0"

PLAN NOTES

1. CONTRACTOR SHALL REUSE EXISTING CABLE TRAY FOR NEW CABLING WHERE POSSIBLE.

2. CONTRACTOR SHALL RETAIN SIEMENS (ORIGINAL EQUIPMENT MANUFACTURER) TO MODIFY THE FOLLOWING EXISTING INFLUENT PUMP STARTERS:
   A. INFLUENT PUMP NO. 1 (M1013) STARTER: SIEMENS 250HP-480V-3ø TYPE 6SL37 SINAMICS G150 DRIVE, ORDER NO. G150A-40250-10310-Z WITH RVSS BYPASS
   B. INFLUENT PUMP NO. 2 (M1014) STARTER: SIEMENS 500HP-480V-3ø TYPE 6SL37 SINAMICS G150 DRIVE, ORDER NO. G150A-40500-10605-Z
   C. INFLUENT PUMP NO. 3 (M1015) STARTER: SIEMENS 500HP-480V-3ø TYPE 6SL37 SINAMICS G150 DRIVE, ORDER NO. G150A-40500-10605-Z
   D. INFLUENT PUMP NO. 4 (M1016) STARTER: SIEMENS 500HP-480V-3ø TYPE 6SL37 SINAMICS G150 DRIVE, ORDER NO. G150A-40500-10605-Z
   E. INFLUENT PUMP NO. 5 (M1017) STARTER: SIEMENS 500HP-480V-3ø TYPE 6SL37 SINAMICS G150 DRIVE, ORDER NO. G150A-40500-10605-Z WITH RVSS BYPASS
   F. INFLUENT PUMP NO. 6 (M1018) STARTER: SIEMENS 250HP-480V-3ø TYPE 6SL37 SINAMICS G150 DRIVE, ORDER NO. G150A-40250-10310-Z

   TO PERFORM THE FOLLOWING WORK FOR EACH STARTER:
   A. PROVIDE SUBMITTALS INDICATING THE PROPOSED EQUIPMENT, WIRING AND PROGRAMMING MODIFICATIONS.
   B. PROVIDE ALL EQUIPMENT, DEVICES, RELAYS, PROGRAMMING, LABOR, ETC. AS REQUIRED TO MODIFY EXISTING STARTERS TO INTEGRATE ALL NEW HARDWIRED I/O AS INDICATED ON THESE PLANS AND ASSOCIATED POINT LISTS. EXISTING STARTERS ARE CURRENTLY CONTROLLED/MONITORED VIA NETWORK INTERFACE, AND GENERAL PROJECT INTENT IS TO REPLACE THIS NETWORK INTERFACE WITH NEW HARDWIRED I/O TO INCREASE SYSTEM RELIABILITY. EXISTING STARTER SETTINGS SHALL THEREFORE BE RECONFIGURED FOR THE PROPOSED HARDWIRED INPUTS/OUTPUTS TO REPLACE THE EXISTING NETWORKED INPUTS/OUTPUTS AS REQUIRED. NOTE THAT INFLUENT PUMP NO. 4 IS FUTURE AND THE ASSOCIATED EXISTING STARTER SHALL BE MODIFIED WITHIN THIS CONTRACT TO MATCH THE OTHER IN-USE STARTERS.
   C. MAINTAIN EXISTING HARDWIRED STARTER INTERCONNECTIONS UNAFFECTED BY THESE MODIFICATIONS (SUCH AS TO SEAL WATER SOLENOID INTERCONNECTIONS).
   D. MAINTAIN EXISTING NETWORK CONNECTIONS FROM SCADA SYSTEM TO STARTERS FOR MONITORING ONLY (NOT CONTROL). WHERE NECESSARY, REDUNDANT NETWORKED POINT TAGS (FOR THESE EXISTING NETWORKED POINTS) SHALL INCLUDE THE SUFFIX "_NETWORKED") TO CLEARLY DELINEATE BETWEEN THE NEW HARDWIRED POINTS AND THE EXISTING NETWORKED POINTS.
   E. PROVIDE FINAL UPDATED WIRING DIAGRAMS (TO BE INSTALLED WITHIN EACH STARTER ENCLOSURE) & O&M's (FOUR HARDCOPIES TO BE PROVIDED TO OWNER) TO CLEARLY INDICATE THE FINAL AS-BUILT CONDITION OF EACH MODIFIED STARTER.
   F. PROVIDE ELECTRONIC COPIES OF ALL FINAL STARTER PROGRAMMING SETTINGS TO OWNER'S PERSONNEL AS DIRECTED BY OWNER.
   G. REMOVE ALL OBSOLETE EQUIPMENT, PROGRAMMING, ETC. AS REQUIRED.

3. CONTRACTOR SHALL RETAIN SIEMENS (ORIGINAL EQUIPMENT MANUFACTURER) TO PROVIDE ALL EQUIPMENT, PROGRAMMING, LABOR, ETC. AS REQUIRED TO MODIFY EXISTING LOSS-OF-POWER MOTOR STARTER FAULT ALARMS FOR ALL EXISTING STARTERS WITHIN INDICATED EXISTING MCC's TO AUTOMATICALLY RESET UPON RESTORATION OF ACCEPTABLE POWER (WITHOUT REQUIREMENT OF A MANUAL LOCAL RESET).

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3-13-2015

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DESIGNED	PDB
DRAWN	DRA
CHECKED	PDB
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REVISIONS

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SHEET TITLE
INFLUENT PUMP STATION ELECTRICAL AREA ELECTRICAL PLAN

ISSUE DATE	SHEET NO.
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SEQUENCE 4 OF 4	