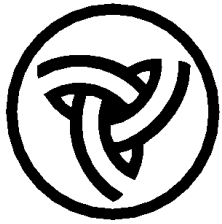


# TRANSPORTATION BULLETIN



Illinois Department of Transportation

## ADDENDUM NO. 2

Dated: July 26, 2010

For: Transportation Bulletin  
Volume 13 No. 26R3 Dated: July 30, 2010

Item No. 1A  
Saint Louis Downtown Airport  
Cahokia, Illinois  
St. Clair County  
Ill. Proj. No. CPS-3906  
AIP No. 3-17-0039-B22

### TO ALL PLAN HOLDERS:

#### Section III - Special Provisions.

ITEM 109 INSTALLTION OF AIRPORT TRANSFORMER VAULT AND VAULT EQUIPMENT

Replace entire section with ADDENDUM NO. 2, ITEM 109 INSTALLTION OF AIRPORT TRANSFORMER VAULT AND VAULT EQUIPMENT (Revised).

**ITEM 109 INSTALLATION OF AIRPORT  
TRANSFORMER VAULT AND VAULT EQUIPMENT**  
(Revised)

**DESCRIPTION**

109-1.1 Revise this section to read as follows:

“Item AR109200, Install Electrical Equipment, shall consist of furnishing and installing all electrical equipment in the vault to perform the vault modifications, as detailed on the Plans and specified herein. This Item shall include all labor, materials, transportation, equipment, wiring, raceways, grounding, tools, utility coordination, relocations, operational instructions, labeling, testing, and all incidentals required to place the vault and associated equipment into proper working order as a completed unit to the satisfaction of the Owner and Engineer.

Included under this Item shall be the following:

- A. Coordinating all work with the Airport Director and/or designated Airport maintenance staff, the respective FAA personnel, and the Resident Engineer.
- B. Furnishing and installing all electrical equipment and support hardware in the vault, as detailed on the Plans and specified herein.
- C. Furnishing and installing all pull boxes, junction boxes, wireways, raceways, conduits, conduit fittings, and ducts in, beneath, and adjacent to the vault. The galvanized rigid steel conduits and associated fittings from the vault to the respective high-voltage manhole located near the vault, as detailed on the Plans and specified herein, shall also be included under this Item.
- D. Furnishing and installing all necessary cable and wiring within or at the vault, as detailed on the Plans and specified herein.
- E. Furnishing and installing all necessary cable, wiring, connections, and work associated with the L-821 control panel at the Air Traffic Control Tower vault, as detailed on the Plans and specified herein.
- F. Furnishing and installing all grounding, as detailed on the Plans and specified herein.
- G. Testing, adjusting, and retesting (where applicable) all new equipment and modifications to existing systems for proper operation.
- H. Labeling all electrical equipment and incidentals necessary to place all of the equipment in operation as a complete unit acceptable to the Owner and Engineer.

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- I. Furnishing operation, maintenance, and installation manuals for all new equipment.”

109-1.2 Item AR109800 “Generator System” shall consist of furnishing and installing a portable generator quick connect and an automatic transfer switch at the vault as detailed on the Plans and specified herein. This item shall include all labor, equipment, wiring, raceways, grounding, materials, tools, utility coordination, operational instructions, labeling, startup and check out services, testing and all incidentals required to place the portable generator quick connect system, automatic transfer switch, and all associated accessories into proper working order as a completed unit to the satisfaction of the Owner and Engineer. Contractor shall also include 2 copies of instruction manuals, operation and maintenance manuals, and parts list bound in a durable plastic binder for the automatic transfer switch.

109-1.3 Item AR109902, Remove Electrical Equipment, shall include removal of the existing 2400 VAC electric service from the point of connection to the respective electric utility lines to the respective equipment in the vault. This shall include removal and disposal of the pothead and transformer or regulator located in the vault and all associated conduits, wiring, connection, fuses, fuse holders, supports, plywood, and materials. All items designated for disposal shall be disposed of in a legal manner off of the Airport Site. This item shall include all labor, tools, coordination, utility coordination, and incidentals required to remove the 2400 VAC service at the vault to the satisfaction of the Owner and Engineer.

109-1.4 Item AR109924, Replace Electric Services shall consist of removing and replacing the respective service disconnect for the Runway 30L VASI system. This service will be used to power the Runway 30L PAPI system that will replace the existing Runway 30L VASI System. This item shall include replacing the respective service conductors and conduit from the existing meter base to the new disconnect equipment, and replacing the existing grounding system as detailed on the Plans and specified herein. This item shall include all labor, equipment, wiring, raceways, grounding, materials, tools, utility coordination, labeling, testing and all incidentals required to remove and replace the respective electric service installation to the satisfaction of the serving electric utility, Owner and Engineer.

Included under this Item shall be the following:

- A. Coordinating all work with the FAA Control Tower personnel, the Airport Director, the Airport maintenance staff, and the Resident Engineer.
- B. Coordinating with the serving electric utility the replacement of the existing service disconnect with a new service disconnect.
- C. Removing the existing service disconnect, conduit and cable and replacing them with a new service disconnect, conduit, and cable as detailed on the Plans and Specified

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herein. Service conductors shall be replaced between the existing meter base and the respective service disconnect.

- D. Replacing the existing ground rod, grounding electrode conductor, and conduit with a new ground rod, grounding electrode conductor, and Schedule 40 PVC conduit as detailed on the Plans and Specified herein.

### 109-1.5 REFERENCES

- A. ANSI C80.1 – Rigid Steel Conduit, Zinc Coated.
- B. ANSI C80.4 – Fittings Rigid Metal Conduit and EMT.
- C. ANSI Z535.4-2002 - American National Standard for Product Safety Signs and Labels.
- D. ASTM Specification B3 – Standard Specification for Soft or Annealed Copper Wire.
- E. ASTM Specification B8 – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
- F. Federal Specification A-A-59544 Cable and Wire, Electrical (Power, Fixed Installation).
- G. FAA AC No. 150/5340-30D “DESIGN AND INSTALLATION DETAILS FOR AIRPORT VISUAL AIDS”.
- H. FAA AC No. 150/5345-7E, (or latest edition) "SPECIFICATIONS FOR L-824 UNDERGROUND ELECTRICAL CABLE FOR AIRPORT LIGHTING CIRCUITS.
- I. FAA AC No. 150/5345-10F “SPECIFICATION FOR CONSTANT CURRENT REGULATORS AND REGULATOR MONITORS”.
- J. FAA AC No. 150/5345-53 “AIRPORT LIGHTING EQUIPMENT CERTIFICATION PROGRAM” (most current issue) and AC150/5345-53C, AIRPORT LIGHTING EQUIPMENT CERTIFICATION PROGRAM Appendix 3 Addendum.
- K. FAA-STD-019d dated August 9, 2002, “LIGHTNING AND SURGE PROTECTION, GROUNDING, BONDING, AND SHIELDING REQUIREMENTS FOR FACILITIES AND ELECTRONIC EQUIPMENT”
- L. NEMA ICS 1 – General Standards for Industrial Control Devices, Controllers, and Assemblies.

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- M. NEMA ICS 2 – Standards for Industrial Control Devices, Controllers, and Assemblies.
- N. NEMA ICS 6 – Enclosures for Industrial Controls and Systems.
- O. NFPA 70 – National Electrical Code (most current issue in force).
- P. NFPA 110 – Emergency and Standby Power Systems
- Q. UL Standard 6 – Rigid Metal Conduit.
- R. UL Standard 44 – Thermoset-Insulated Wires and Cables.
- S. UL Standard 83 – Thermoplastic-Insulated Wires and Cables.
- T. UL Standard 467 – Grounding and Bonding Equipment.
- U. UL Standard 486A-486B Wire Connectors.
- V. UL Standard 514B – Conduit, Tubing and Cable Fittings.
- W. UL Standard 854 – Service Entrance Cables.
- X. UL 1008 – Standard for Safety Transfer Switch Equipment.

109-1.6 SHOP DRAWINGS. The Contractor shall furnish shop drawings for approval before ordering equipment and/or materials. Shop drawings are required for vault equipment and materials to be used on the project. **Shop drawings shall be clear and legible. Copies that are illegible will be rejected.** Contractor shall submit sufficient copies of shop drawings to meet the needs of his personnel, sub-contractor personnel, and equipment suppliers plus 4 copies to be retained by the Project Engineer. Shop drawings shall include the following information:

- A. Certification of compliance with the Airport Improvement Program Buy American Requirement and the Buy American Act for all materials and equipment.
- B. In order to expedite the shop drawing review, inspection and/or testing of materials and equipment, the Contractor shall furnish complete statements to the Project Engineer as to the origin and manufacturer of all materials and equipment to be used in the work. Such statements shall be furnished promptly after execution of the contract but, in all cases, prior to delivery of such materials and equipment.
- C. Cut sheets with part number and specifications for the service breaker. Coordinate selection of the service breaker with the automatic transfer switch to maintain the withstand and closing ratings of the transfer switch.

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- D. Automatic transfer switch. Provide catalog sheets, manufacturer, model number, voltage, switch size, Amperage rating, number of poles, operating logic, withstand and closing ratings, dimensions, and enclosure details. Coordinate auto transfer switch withstand and closing ratings with the service entrance breaker/disconnect to maintain the withstand and closing ratings of the switch.
- E. Submittals for panelboards shall include manufacturer, catalog numbers, panel schedule, voltage and amperage ratings, bus material, integrated short circuit ampere rating, circuit breaker arrangement and sizes and respective enclosure.
- F. Cut sheets with part numbers and specifications for each double throw (fusible or not fusible) safety switch.
- G. Cut sheets with part number and specifications for the constant current regulators. Include list of spare parts.
- H. Cut sheets with part number and specifications for the S-1 cutouts and enclosures.
- I. Provide cut sheets for all types of conduit and raceway used in the vault (for example galvanized rigid steel conduit, UL listed liquid tight flexible metal conduit, wireway, and pull boxes). Include certification that steel conduits are made with 100 percent domestic steel.
- J. Provide cut sheets for the power and control circuit conductors.

### **EQUIPMENT AND MATERIALS**

#### 109-2.1 GENERAL. Add the following to this section:

- “C. FAA approval of Airport lighting equipment and subsequent inclusion in Advisory Circular 150/5345-1, "Approved Airport Equipment", and/or Advisory Circular 150/5345-53, “Airport Lighting Equipment Certification Program”, only means that the test data satisfied the applicable Specification requirements. This does not insure that the approved equipment will satisfactorily operate when connected power-wise and/or control-wise to other approved airport lighting equipment or "off the shelf" equipment not requiring FAA approval.
- D. The Contractor shall ascertain that all lighting system components furnished by him (including FAA-approved equipment) are compatible in all respects with each other and the remainder of the new system. Any non-compatible components furnished by the Contractor shall be replaced by him, at no additional cost to the Airport Sponsor, with a similar unit approved by the Engineer (different model or different manufacturer) that is compatible with the remainder of the Airport lighting system.

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- E. Except as specified otherwise, all new equipment shall be provided by the Contractor and shall be tested for Specification conformance as part of the Aviation Lighting Equipment Certification Program. Certification of conformance, as tested by the testing laboratory, shall be provided by the manufacturer for all items submitted for approval.”

109-2.4 BRICK. Delete this section.

109-2.5 RIGID STEEL CONDUIT. Add the following:

“Rigid Steel Conduit and fittings shall be hot-dipped, galvanized, UL-listed, and produced in accordance with UL Standard 6 – Rigid Metal Conduit and ANSI C80.1 – Rigid Steel Conduit, Zinc Coated. Couplings, connectors, and fittings for rigid steel conduit shall be threaded, galvanized steel or galvanized, malleable iron, specifically designed and manufactured for the purpose. Fittings shall conform to ANSI C80.4 – Fittings Rigid Metal Conduit and EMT and UL 514B – Conduit, Tubing, and Cable Fittings. Set screw type fittings are not acceptable. Galvanized rigid steel conduit shall be produced from 100 percent domestic steel. Contractor shall provide certification that the respective steel conduits used on this project are manufactured from 100 percent domestic steel.”

109-2.6 LIGHTING. Delete this section.

109-2.10 HIGH-VOLTAGE BUS. Delete this section.

109-2.11 BUS CONNECTORS. Delete this section.

109-2.12 BUS SUPPORTS. Delete this section.

109-2.13 GROUND BUS. Delete this section.

109-2.14 SQUARE DUCT. Revise the last sentence to read:

“Square duct shall be sized, as detailed on the Plans.”

Add the following:

“Wireway shall be installed, as indicated on the Plans, including, but not limited to, straight lengths, elbows, tees, offsets, panel adaptors, closing plates, wire retainers, and supports, as required for a complete installation. Wireways shall be constructed of 16-gauge steel before finishes are applied. All straight lengths of wireway shall have hinged or bolt-on covers. Lengths shall be provided with cover latches, a minimum of every 3 ft, which shall hold the cover securely in-place when closed. Sealing ears shall be provided on both the wireway lengths and connector covers so that the entire run can be sealed.

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Wireways shall be 6 in. by 6 in., as detailed on the Plans. Wireways shall be furnished without knockouts. Connectors shall be slip-in type with self-retained mounting screws. They shall also have the feature to allow “lay-in” of all conductors. Wireways shall be provided with a gray, epoxy-painted finish applied over a corrosion-resistant, phosphate primer. All wireway lengths and accessories shall be UL-listed and labeled in conformance with UL 870 Standards for Wireways, Auxiliary Gutters, and Associated Fittings and conform to NEMA 1 enclosure rating.”

109-2.16 POTHEADS. Delete this section.

109-2.17 PREFABRICATED METAL HOUSING. Delete this section.

109-2.18 FAA-APPROVED EQUIPMENT. Add the following:

- A. Constant Current Regulator for Runway 12R-30L. Constant current regulator for Runway 12R-30LR shall be a 20 KW, L-828 constant current regulator, 240 VAC, single-phase, 60 Hertz input, Class 1 - 6.6-Amps output, Style 2 with five output brightness steps (2.8, 3.4, 4.1, 5.2, and 6.6-Amps). Constant current regulator shall comply with FAA AC 150/5345-10F for Type L-828 regulator. Constant current regulator shall be capable of properly operating the respective airfield lighting system it is powering. Constant current regulator shall be dry-type ferro-resonant, dry-type ferro-magnetic reactor, or dry-type saturable-reactor type regulator. Constant current regulator shall not have solid state controls in the series circuit and shall be designed for no radio communication interference. Solid state electronic designs are not acceptable. Constant current regulator shall include open circuit protection, over current protection, output current ammeter, elapsed time meter (for total time on), output voltmeter, and lightning and transient protection on input and output lines. Constant current regulators shall also include a remote/local control feature with selections for “Remote, Off, B1-0.15% Brightness, B2-1.2% Brightness, B3-5% Brightness, B4-25% Brightness, and B5-100% Brightness”. Control voltage shall be 120 VAC (internal). Constant current regulators furnished on this project shall be from the same manufacturer. Include the following spare components:
1. One spare control circuit board for each type in the constant current regulator
  2. Primary switch contactor
  3. Lightning arresters (input and output)
  4. Control circuit fuses or breaker.
- B. Backup Constant Current Regulator for Runway 12R-30L. Backup Constant current regulator for Runway 12R-30LR shall be a 20 KW, L-828 constant current regulator, 240 VAC, single-phase, 60 Hertz input, Class 1 - 6.6-Amps



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output, Style 2 with five output brightness steps (2.8, 3.4, 4.1, 5.2, and 6.6-Amps). Constant current regulator shall comply with FAA AC 150/5345-10F for Type L-828 regulator. Constant current regulator shall be capable of properly operating the respective airfield lighting system it is powering. Constant current regulator shall be dry-type ferro-resonant, dry-type ferro-magnetic reactor, or dry-type saturable-reactor type regulator. Constant current regulator shall not have solid state controls in the series circuit and shall be designed for no radio communication interference. Solid state electronic designs are not acceptable. Constant current regulator shall include open circuit protection, over current protection, output current ammeter, elapsed time meter (for total time on), output voltmeter, and lightning and transient protection on input and output lines. Constant current regulators shall also include a remote/local control feature with selections for "Remote, Off, B1-0.15% Brightness, B2-1.2% Brightness, B3-5% Brightness, B4-25% Brightness, and B5-100% Brightness". Control voltage shall be 120 VAC (internal). Constant current regulators furnished on this project shall be from the same manufacturer. Include the following spare components:

1. One spare control circuit board for each type in the constant current regulator
2. Primary switch contactor
3. Lightning arresters (input and output)
4. Control circuit fuses or breaker.

### 109-2.19 OTHER ELECTRICAL EQUIPMENT. Add the following:

"Contractor shall confirm quantity for all electrical equipment with the Plans. Proposed electrical equipment for the vault shall be as follows:

- A. Service Breaker. Service breaker for the vault shall be a 240 VAC, 800 Amp, 2-pole circuit breaker with 65,000 AIC (minimum) rating at 240 VAC in a NEMA 1 enclosure UL listed suitable for service entrance. Circuit breaker shall be rated as Service Entrance Equipment, Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents. **Coordinate selection of this breaker with the Automatic Transfer Switch (ATS) to maintain the withstand and closing ratings rating of the ATS.** Include solid neutral and separate equipment ground bar. Circuit Breaker enclosure shall be pad lockable in the "OFF" position. Circuit breaker shall be manufactured by Square D Company; a brand of Schneider Electric, Eaton Electrical Inc.; Cutler-Hammer Business Unit, General Electric Company; GE Consumer & Industrial - Electrical Distribution, or approved equal.
- B. Portable Generator Quick Connect. Provide a portable generator docking station/system rated for 800 amps at 120/240 VAC, single phase, 3-wire with ground. Portable generator quick connect system shall be an 800 Amp,

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120/240 VAC single phase, Camlok Docking Station with Male Camlok input, in a NEMA 3R stainless steel enclosure. Bus shall be Copper. Provide 2-Camlok interfaces for each phase and neutral and 1-Camlock interface for ground. Each Camlok interface shall be color coded Phase A-Black, Phase B-Red, Neutral-White, and Ground-Green. Camlok Docking Station shall be UL listed. Include 7 portable generator power cable coils (2 sets for each phase and neutral, and 1 set for ground) of #4/0 AWG Copper UL Type PPE 2000 Volt, 75 Degree C wet, Portable Generator Cables manufactured to UL Standard 1581, each 50 feet minimum in length. Cables shall be fitted with Male to Female Crouse-Hinds Camlok connectors that are compatible with the generator docking station. Cable insulation shall be color coded Black for Phase A, Red for Phase B. White for Neutral, and Green for Ground. Portable generator cables shall be manufactured by Trystar Bridgewater Tech Inc. Part number TSPPC or approved equal. Include 7 pigtails (same size as portable generator cables) 3 feet minimum in length with Female Crouse-Hinds Camlok to bare end for interface to a portable generator. Pigtails shall be rated 400 Amps each. Pigtail colors shall be Black for Phase A, Red for Phase B. White for Neutral, and Green for Ground. Pigtails shall be manufactured by Trystar Bridgewater Tech Inc. Part Number TSPPC or approved equal. Portable generator quick connect/Camlok docking station shall be manufactured by Trystar Bridgewater Tech Inc. Part Number TSDOCKHD or approved equal. Trystar Bridgewater Tech Inc. can be contacted with the following information: Address: 2917 Industrial Drive, Faribault, Minnesota 55021, Phone: 507-333-3990, Fax: 507-333-3991.

- C. Main Distribution Panelboard "A". Main distribution panel shall be 800 Amp, 120/240 VAC, 1-phase, 3 wire with solid neutral with 800 Amp, 2 pole main breaker, copper bus braced for 42,000 Amperes symmetrical (minimum) at 240 VAC, 45 in. of breaker mounting space, suitable for 800 Amp frame max branch breakers, in a NEMA 1 enclosure UL listed, sized in accordance with UL 67, Square D, I-line, Type HCP Series, or approved equal. All bussing shall be copper. Neutral bus shall be copper. Include separate copper equipment ground bars adequately sized for all ground wires and grounding electrode conductors to and from the panel. Main breaker and all branch and feeder breakers shall have an interrupting rating of 25,000 Amps minimum at 240 VAC and shall be constructed in accordance with NEMA AB1 and UL 489. Circuit breakers shall be equipped with individually insulated braced and protected connectors. The front faces of all circuit breakers shall be flush with each other. Large, permanent, individual circuit numbers shall be affixed to each breaker in a uniform position (or equip each breaker with a circuit card holder and neatly printed card identifying the circuit). Tripped indication shall be clearly shown by the breaker handle taking a position between ON and OFF. Provisions for additional breakers shall be such that no additional connectors will be required to add breakers. See Plans for details on size and quantity of branch and feeder breakers. Panel shall be UL-listed and bear the UL label. Provide legend plates as detailed on the Plans. Also identify the

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main service breaker per the requirements of NEC 230.70 (B). Coordinate selection of two pole breakers with the manufacturer to confirm proper bus connections.

- D. Transient Voltage Surge Suppressor (TVSS) for Main Distribution Panel. AC power surge arrester/TVSS shall be UL-listed per UL 1449, Second Edition, and shall conform to the applicable requirements of FAA-STD-019d dated August 9, 2002, "LIGHTNING AND SURGE PROTECTION, GROUNDING, BONDING, AND SHIELDING REQUIREMENTS FOR FACILITIES AND ELECTRONIC EQUIPMENT". AC power surge arrester/TVSS for the main distribution panel shall be suitable for a 120/240 VAC, 1-phase, 3-wire, plus ground system with a surge current rating of 240,000-Amps, 8 x 20 microsecond wave per mode (L-L, L-N, L-G, N-G), and status indication lights in a NEMA 12-rated enclosure, Lightning Protection Corporation Model LPC 2020-8U-G, or approved equal. Include six spare indicator lamps with each AC power surge arrester/TVSS.
- E. Circuit Breaker Panelboard "B". Circuit breaker panelboard shall be rated 120/240 VAC, 1 phase, 3-wire and shall have copper bus structure braced for 22,000 RMS Amperes fault current minimum at 120/240 VAC. All copper parts shall be plated to prevent corrosion. Panelboards shall bear the UL label. Panelboards for service entrance applications shall be UL-listed suitable for service entrance. All panelboards shall be dead-front safety-type, equipped with thermal magnetic-molded case breakers and solid neutral bus. Bus bar connections to the branch circuit breakers shall be the "Distributed Phase" or "Phase Sequence" type. Bussing shall be such that adjacent single-pole breakers will be on different phases or polarities, and that two pole breakers can be installed at any location. Panelboard numbering shall be such that starting at the top, odd numbers shall be used in sequence down the left hand side, and even numbers shall be used in sequence down the right hand side. Cabinets shall be fabricated of code-gauge, galvanized steel with gutters per the NEC. Fronts shall have doors with matching one-piece trim, be code-gauge, and be finished with rust-inhibiting primer and baked enamel. Fronts shall have adjustable indicating trim clamps completely concealed when door is closed. Provide a circuit directory frame and card with a clear plastic covering on the inside of the doors. Fronts shall have flush locks, and be furnished with two keys per lock. Provide circuit breakers, quick-make, quick-break, thermal-magnetic, trip indicating, and common trip on all multi-pole breakers. Handles shall have "ON", "OFF" and "TRIPPED" positions. Circuit breakers shall be UL-listed in accordance with UL Standard 489. Breakers shall have bolt-on connections to the bus. Amperage trip ratings, voltage ratings, interrupting current ratings, and number of poles shall be as shown on the panelboard schedules. Contractor shall confirm and adjust circuit breaker sizes, as required for the respective equipment or device being fed, in accordance with the respective equipment manufacturer's

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recommendation and the NEC. Panelboards shall be furnished with copper-ground bus and separate insulated copper neutral bus.

- F. Double Throw Not Fusible Safety Switch. Double throw not fusible safety switch for use as a manual transfer switch shall be UL listed, heavy duty, 200 Amp, 240 VAC, 2-pole with equipment ground kit in a NEMA 1 enclosure, Cutler-Hammer Catalog Number DT224UGK with ground kit or approved equal. Switch must be suitable to connect a single power source to either of two different loads. The switch will be used to connect power to either of two different constant current regulators. Switches that void the UL listing for this application are not acceptable.
- G. Double Throw Fusible Safety Switches. Double throw fusible safety switches for use as a manual transfer switch shall be UL listed, heavy duty, 240 VAC, 2-pole with Amperage ratings as detailed on the Plans and equipment ground kit in a NEMA 1 enclosure as manufactured by Cutler-Hammer or approved equal. Switch must be suitable to connect a single power source to either of two different loads. The switch will be used to connect power to either of two different constant current regulators. Switches that are not rated for this application or that void the UL listing for this application are not acceptable.
- H. Fuses. Fuses shall be the size and type as shown on the Plans. Fuses shall be manufactured by Bussmann, Littlefuse, or approved equal. Furnish two additional fuses of each size and type used on the project, for use as spares.
- I. Type S-1 Series Plug Cutouts. Provide series plug cutouts for each constant current regulator as detailed on the Plans. Series plug cutouts shall be Type S-1, rated 5KV, 20-Amp, and shall comply with FAA AC 150/5340-4C. Cutouts shall be certified by the manufacturer as suitable for the respective application. Cutouts for the runway series circuits will be wired for manual transfer operation (one series circuit loop with the capability of being powered from either of two constant current regulator power sources). Series plug cutouts shall be Crouse-Hinds, Type S-1, Model 2, Catalog Number 30775, or an approved equal. Series cutouts where the manufacturer has noted their cutouts are not recommended to operate with the handle pulled/removed are not acceptable. Other cutouts, that do not function the same as the Crouse-Hinds, Type S-1, Model 2, Catalog Number 30775 units, are not acceptable. Install the series plug cutouts in a NEMA 1 or NEMA 12 painted steel enclosure adequately sized to house the cutout(s), with a hinged cover and back panel to mount the cutouts. All enclosures shall be pad lockable.
- J. Lighting Contactor Panel for Airfield NAVAIDS. The lighting contactor panel for use with the REILS for Runway 12R is an existing panel. It has two spare lighting contactors available for use with the Runway 12R REILS. Provide legend plates to identify the respective lighting contactors and “Hand-Off-Auto” selector switches.

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- K. High-Voltage Pull Box. Junction and pull boxes shall be sized, as required for conductors and splices, and per 2008 NEC Article 314. Boxes shall be UL-listed. Special boxes made to suit conditions shall be used to accommodate the respective application, or where required by the NEC, even though they might not be indicated on the Drawings. The high-voltage pull box to be installed inside the vault for transitioning from the high voltage handhole/manhole shall be a NEMA 12 enclosure with hinged cover sized, as detailed on the Plans, and manufactured by Hoffman, or approved equal.
- L. Liquid-Tight, Flexible Metal Conduit. Liquid-tight, flexible metal conduit shall consist of polyvinyl jacket over flexible, hot-dip, galvanized steel tubing. The flexible conduit shall be completely sealed from liquids, dust, dirt, and fumes and be resistant to oil, gasoline, grease, and abrasion. Jacket shall also be sunlight-resistant. Liquid-tight, flexible metal conduit shall be UL-listed, suitable for use as a grounding conductor, and comply with Article 350 of the NEC. **Liquid-tight, flexible metal conduit and associated fittings shall be UL-listed to meet the requirements of NEC 350.6.** Liquid-tight, flexible metal conduit shall be Anaconda Sealtite Type UA, as manufactured by Anamet Electrical Inc., 1000 Broadway Avenue East, Mattoon, Illinois 61938-0039, Phone: 217-234-8844, Liguatite Type LA, as manufactured by Electri-Flex Company, 222 W. Central Ave., Roselle, Illinois 60172, Phone: 630-529-2920 or 1-800-323-6174, or approved equal. Do not install liquid-tight, flexible metal conduit that is not UL listed. Confirm liquid-tight, flexible metal conduit bears the UL label prior to installation.”

### 109-2.20 WIRE. Add the following to Section A. Control Circuits:

“Control wiring that is used to interface the lighting contactor panel in the vault to the respective 48 VDC pilot relay panels shall be #12 AWG copper-type THWN.

THWN Wire. Cable shall comply with Underwriters’ Laboratories Standard UL-83 and Federal Specification A-A-59544. Conductor shall be soft-annealed, uncoated copper, and shall comply with ASTM B3 and B8. Insulation shall be rated for 600-Volt. Insulation shall be PVC conforming to Underwriters’ Laboratories requirements for Type THW. The outer covering shall be nylon-conforming to Underwriters’ Laboratories for type THHN or THWN. Cable shall be UL-listed and marked THWN. Power and control wiring shall be Encore, Superior Essex, Southwire Company Type THWN, or approved equal.”

Delete paragraphs 1, 2, and 3 under Section B. Power Circuits.

Add the following:

“Power Cable (600-Volt and Below). All power wiring, 600-Volt and below, shall be the type, size, and number of conductors, as noted on the Plans.

THWN Wire. Cable shall comply with Underwriters' Laboratories Standard UL-83 and Federal Specification A-A-59544. Conductor shall be soft-annealed, uncoated copper and shall comply with ASTM B3 and B8. Insulation shall be rated for 600-Volt. Insulation shall be PVC conforming to Underwriters' Laboratories requirements for Type THW. The outer covering shall be nylon-conforming to Underwriters' Laboratories for type THHN or THWN. Cable shall be UL-listed and marked THWN-2. Power and control wiring shall be Encore, Superior Essex, Southwire Company Type THWN-2, or approved equal. **Note: Where THWN wiring is referenced on the Plans, it shall be THWN-2.**

XHHW Wire. Cable shall be UL-listed as Type XHHW-2 per UL Standard 44 for Rubber-Insulated Wires and Cables. Cable shall also conform to ICEA S-95-658/NEMA WC70 and Federal Specification J-C-30B. Conductors shall be Class B stranded, annealed, uncoated copper per UL Standard 44. Insulation shall be rated for 600-Volt. Insulation shall be cross-linked polyethylene complying with the physical and electrical requirements of UL Standard 44 for Type XHHW-2. XHHW wire may be used in place of THWN wire for all applications and shall be Southwire Type XHHW-2, or approved equal.

XLP-USE Wire. Cable shall comply with UL Standard 44, UL Standard 854, and Federal Specification A-A-59544. Conductor shall be concentric-strand, soft copper, conforming to ASTM B8 and Underwriters' Laboratories Standard UL44 for Rubber Insulated Wires. Insulation shall be rated for 600-Volt. Insulation shall be cross-linked polyethylene conforming to Underwriter's Laboratories Requirements for Type USE-2 insulation. Cable shall be UL-listed and marked USE-2. Cable shall be Service Wire Company Type USE-2, or approved equal.

Grounding electrode conductors and/or bonding jumpers shall be the size and type, as detailed on the Plans."

109-2.21 FLOOR DRAINS. Delete this section.

109-2.22 AUTO TRANSFER SWITCH. Automatic transfer switch shall be an electrically operated, mechanically held type, rated for continuous load, 800 Amp, 2-pole with solid neutral, 120/240 VAC 1 phase, three wire, 60 Hz, with a separate equipment ground bar adequately sized for all ground wires to and from the switch, in a NEMA 12 enclosure. Automatic transfer switch shall conform to the requirements of NEMA Standard ICS2 and Underwriters' Laboratories UL-1008 and shall be rated in Amperes for total system transfer including control of motors, electric-discharge lamps, electric-heating and tungsten-filament lamp loads. Automatic transfer switch shall be rated for all classes of load and suitable for the respective airfield lighting and vault equipment loads. Voltage and current ratings shall be as shown on the drawings. Transfer switches shall have withstand and closing rating of 65,000 RMS Sym. Amps., minimum per UL Standard 1008. Coordinate selection of the service entrance breaker/disconnect to maintain the withstand and closing ratings of the switch. **Automatic transfer switch**

**and associated controls shall be suitable for use with a portable engine generator set and suitable to accommodate a future standby engine generator set.**

A. AUTOMATIC TRANSFER SWITCH SHALL INCLUDE THE FOLLOWING OPTIONS AND FEATURES:

1. Voltage sensing for each phase of normal source. Pick-up voltage is adjustable from 85 percent to 100 percent nominal, and drop-out voltage is adjustable from 75 percent to 98 percent pick-up value. Factory set for pick-up at 90 percent and drop-out at 85 percent.
2. Emergency/Standby Source Monitor: Monitor alternate source voltage and frequency; inhibit transfer when voltage is below 85 percent or frequency varies more than 3 percent (adjustable from 90% to 100%) from rated nominal value.
3. Time delay to override momentary normal source outages to delay all transfer switch and engine starting signals. Adjustable from 0.5 to 6 seconds.
4. Voltage/Frequency Lockout Relay: Prevent premature transfer. Voltage pick-up is adjustable from 85 percent to 100 percent nominal. Factory set to pick-up at 90 percent. Pick-up frequency is adjustable from 90 percent to 100 percent nominal. Factory set to pick-up at 95 percent.
5. Retransfer to normal time delay, adjustable from 0 to 30 minutes. Bypass time delay in event of emergency/standby source failure.
6. Unloaded running time delay for emergency/standby engine generator cool down period adjustable from 0 to 30 minutes.
7. Transfer to emergency/standby time delay, adjustable for 0 to 5 minutes for controlled timing of load transfer to emergency/standby power source.
8. Test Switch: Mount in cover of enclosure to simulate failure of normal source.
9. Transfer Override Switch: Overrides automatic retransfer control so the ATS will remain connected to the emergency power source regardless of the condition of the normal source. A pilot light indicates the override status.
10. Return to Normal Switch: Mount in cover of enclosure to initiate manual transfer from emergency/standby to normal source.
11. Indicating Lights: Mount in cover of enclosure to indicate NORMAL SOURCE AVAILABLE, STANDBY SOURCE AVAILABLE, NORMAL SWITCH POSITION, and STANDBY SWITCH POSITION.

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12. Transfer Switch Auxiliary Contacts: Two normally open on normal switch position, closed on emergency/standby switch position. Two normally closed on normal switch position, open on emergency/standby switch position.
13. Engine generator start and stop control contacts.
14. Engine generator exercise timer (2 weeks), with toggle switch to select load or no load operation.
15. Equipment ground bar adequately sized for all ground wires to and from the transfer switch. Install one ground wire per ground lug terminal unless the lug is rated and listed for multiple conductors.

### B. AUTOMATIC SEQUENCE OF OPERATION

1. When normal (commercial) service drops below preset percentage of rated voltage and remains for specified time delay, contact closure in the transfer switch will signal the engine generator to start. When engine generator output reaches proper voltage and frequency, the transfer switch will transfer load to the generator. Time delay before transfer to alternate power source shall be 0 to 60 seconds, adjustable.
2. When normal (commercial) source returns to preset percentage of rated voltage and frequency, and after specified time delay, load retransfers to normal source, through the in phase monitor.
3. Engine generator start control to remain closed to allow engine generator to run (unloaded) for preset time after retransfer before shutdown. Cool down period for engine generator shall be as recommended by the engine generator manufacturer.
4. Control relays, etc. to reset instantaneously, ready for next automatic operation.

### C. ENCLOSURE

1. Enclosure shall be NEMA Type 12, painted steel, free standing type unit with hinged door.
2. Finish shall be manufacturer's standard gray enamel or green enamel.

### D. ACCEPTABLE PRODUCTS

1. Automatic Switch Company 7000 Series



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2. Onan/Cummins Model OHPC Series Power Command
3. Or approved equal.

### CONSTRUCTION METHODS

#### 109-3.10 GENERAL. Add the following to this section:

“The Contractor shall furnish and install all materials necessary for complete and operational installation of the vault equipment, as specified herein, and as shown on the Plans. The complete installation and wiring shall be done in a neat, workmanlike manner. All electrical work shall comply with the requirements of the NFPA 70 – National Electrical Code (NEC), most current issue in force, and all other applicable local codes, laws, ordinances, and requirements in force. Electrical equipment shall be installed in conformance with the respective manufacturer’s directions and recommendations for the respective application. Any installations which void the UL listing, ETL listing (or other third party listing), and/or the manufacturer’s warranty of a device will not be permitted.

- A. Contractor shall keep a copy of the latest National Electrical Code in force on site at all times during construction for use as a reference.
- B. Contractor shall keep a copy of the Plans, Special Provision Specifications including any addenda, and copies of any change orders on site at all times during construction.
- C. Contractor shall coordinate work and any power outages with the Airport Director (**Robert McDaniel, St. Louis Downtown Airport, 1680 Sauget Industrial Parkway, Sauget, Illinois 62206-1449, Phone: 618-337-6060, Fax: 618-337-1597**) and/or the Airport Maintenance Manager (**Bobby Toenjes, Phone: 618-337-6060, Cell Phone: 314-486-5639**), and the Resident Engineer. Any shutdown of existing systems shall be scheduled with and approved by the Airport Director prior to shutdown. Once shut down, the circuits shall be labeled as such to prevent accidental energizing of the respective circuits. All personnel shall follow U.S. Department of Labor Occupational Safety & Health Administration (OSHA) 29 CFR Part 1910 Occupational Safety and Health Standards for electrical safety and lockout/tagout procedures including, but not limited to, 29 CFR section 1910.147 The Control of Hazardous Energy (lockout/tagout).
- D. All electrical equipment installed by the Contractor shall be properly labeled, and all cables must be tagged.
- E. All changes to the airfield lighting system control wiring will be documented by the Contractor and provided to the Resident Engineer.

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- F. All power and control cables shall be installed in conduit, wireways, pull boxes, junction boxes, or raceways. No exposed power or control wiring will be permitted.
- G. Locate Existing Underground Utilities and Cables. The location, size, and type of material of existing underground and/or aboveground utilities indicated on the Plans are not represented as being accurate, sufficient, or complete. Neither the Owner nor the Engineer assumes any responsibility whatever in respect to the accuracy, completeness, or sufficiency of the information. There is no guarantee, either expressed or implied, that the locations, size, and type of material of existing underground utilities indicated are representative of those to be encountered in the construction. It shall be the Contractor's responsibility to determine the actual location of all such facilities, including service connections to underground utilities. Prior to construction, the Contractor shall notify the utility companies of his operational plans, and shall obtain, from the respective utility companies, detailed information and assistance relative to the location of their facilities and the working schedule of the companies for removal or adjustment, where required. In the event an unexpected utility interference is encountered during construction, the Contractor shall immediately notify the utility company of jurisdiction. The Owner's Representative and/or the Resident Engineer shall also be immediately notified. Any damage to such mains and services shall be restored to service at once and paid for by the Contractor at no additional cost to the Contract. All utility cables and lines shall be located by the respective utility. **Contact JULIE (Joint Utility Location Information for Excavators) for utility information, phone: 1-800-892-0123.** Contact the FAA (Federal Aviation Administration) for assistance in locating FAA cables and utilities. Location of FAA power, control, and communication cables shall be coordinated with and/or located by the FAA. Also contact Airport Director/Manager and Airport Personnel for assistance in locating underground Airport cables and/or utilities. Also coordinate work with all aboveground utilities."

### 109-3.11 POWER SUPPLY EQUIPMENT. Add the following to this section:

"Constant Current Regulators. Install constant current regulators in conformance with the manufacturer's recommendations, as detailed on the Plans and as specified herein. Maintain working clearances in front of constant current regulators per the requirements of NEC 110.26 and 110.34. Maintain clearance around constant current regulators for air flow and cooling per the respective manufacturer's recommendations. Confirm circuit breaker sizes for constant current regulators are sized in conformance with the respective manufacturer's recommendations and/or requirements and NEC. Where necessary to accommodate the respective constant current regulator input amperage requirements, circuit breakers, conductors, and conduits shall be adjusted

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(increased in size) to meet the manufacturer's recommendations and/or requirements and the NEC. Conduit connections to constant current regulators shall be with UL-listed, liquid-tight, flexible metal conduit. Include an external bonding jumper or internal equipment ground wire with each piece of liquid-tight, flexible metal conduit that is connected to a constant current regulator to comply with NEC 350.60. Furnish and install control wiring, as detailed on the Plans. Bond each constant current regulator enclosure frame, to the vault ground bus with a #6 AWG (minimum), bare-stranded, copper-bonding jumper."

### 109-3.12 SWITCHGEAR AND PANELS. Add the following to this section:

- A. Installation of Safety Switches and Enclosed Circuit Breakers: All safety switches and enclosed circuit breakers shall be provided with appropriate mounting hardware and strut support. Strut support shall be hot dipped, galvanized steel strut support; Unistrut P-1000-HG, stainless steel strut support; Unistrut P-1000-SS, or approved equal. Provide zinc rich paint applied to field cuts of galvanized steel strut support to minimum the potential for corrosion per the respective strut support manufacturer's recommendation. All hardware shall be corrosion resistant. Mount safety switches and circuit breakers securely in accordance with the manufacturer's recommendations/instructions for the respective application. Inspect all safety switches and circuit breakers for proper operation, tight and secure connections, and correctness. All safety switch and circuit breaker enclosures shall be bonded to ground with a ground lug or bar and ground wire. Field cut holes in safety switch enclosures to accommodate conduit entrances. Where safety switches and/or circuit breaker enclosures are provided with concentric knockouts, and the respective conduit does not use the largest knockout, install a grounding bushing with ground wire connections between the bushing and the ground bus. Do not use safety switch or circuit breaker enclosures for a splice box or for a pull box. Do not route control wires or other circuit wiring through a safety switch or circuit breaker enclosure. Provide weatherproof abrasion resistant, engraved legend plates for each safety switch and enclosed circuit breaker noting the device served, the power source, and the voltage system.
- B. Installation of Automatic Transfer Switch. Install transfer switches in accordance with manufacturer's instructions and as detailed on the Plans. Provide engraved plastic legend plates identifying the transfer switch and the voltage system. Include additional legend plates noting the respective power sources (for both feeds) and their respective locations.
1. Examination. Inspect transfer switch for damage, rust or corrosion, broken or loose wiring, secure connections, etc. Verify proper installation and proper operation of transfer switch. Verify that mounting surface location is suitable for transfer switch installation. Coordinate inspection

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of the automatic transfer switch with the serving electric utility to verify it conforms to their requirements.

2. **Manufacturer's Field Services.** Provide checkout, inspection, start-up, adjustments, and any other required services in order to provide a complete and operational system. Provide label on inner and outer door with name, address, phone number and emergency phone number of the service representative for the transfer switch. Program engine generator exercise timer and coordinate time of operation with the Airport Manager. Provide three copies of operation and maintenance manuals for the automatic transfer switch.
  3. **Demonstration.** Provide systems demonstration. Demonstrate operation of transfer switch in normal, and emergency modes, instruct use personnel on the operation of the transfer switch. Note to user personnel items requiring adjustments for operation where applicable. Verify all equipment operates properly on each power source.
- C. **Installation of Panelboards.** Panelboards shall be thoroughly inspected for physical damage, proper alignment, anchorage, and grounding. The exterior finish shall be inspected for blemishes, nicks, and bare spots and touched up, as required, using matching touch-up paint. Inspections shall be made for proper installation and tightness of connections for circuit breakers. Install panelboards, as shown on the Plans and in accordance with NEMA PB1.1. Maximum distance from floor to highest breaker shall not exceed 6 ft-6 in. Install panelboards plumb. Install circuit breakers in panelboards in conformance with the respective manufacturer's directions. Connect only one wire/cable to each breaker terminal. Provide filler plates for unused spaces in panelboards. Provide typed circuit directory for each branch circuit panelboard to identify the respective device fed by each circuit breaker. Revise directory to reflect circuiting changes, as required. Provide legend plates for all panelboards to identify the panelboard designation, the power source, and the voltage system. Legend plates shall be weatherproof and abrasion-resistant, phenolic material. Lettering shall be black on white background. Panelboards shall be thoroughly tested after installation and connection to respective loads.
- D. **Surge Protector Device Installation.** Install Surge Protector Devices (SPD)/TVSS devices in conformance with of FAA-STD-019d, dated August 9, 2002, "LIGHTNING AND SURGE PROTECTION, GROUNDING, BONDING AND SHIELDING REQUIREMENTS FOR FACILITIES AND ELECTRONIC EQUIPMENT" and the respective manufacturer's directions and recommendations. Contractor shall confirm all connections to the surge arrester (phases, neutral, and ground) are completed and secure. Connection leads to the surge arrester shall be sized per the respective manufacturer's recommendation and as detailed herein, and shall be maintained as short as

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possible, maximum 2 ft in length, and laced together for mutual coupling. The conduit or conduit nipple connecting the SPD/TVSS device enclosure to the panel enclosure shall be sealed with duct seal or other nonflammable medium to prevent soot from entering the enclosure in the event of a SPD/TVSS device failure.

- E. Installation of Control Panels. Install control panels, as detailed on the Plans and in conformance with the respective panel manufacturer's requirements and/or recommendations.
- F. Installation of S-1-Type Cutouts. Install plug cutouts in conformance with the manufacturer's recommendations, as detailed on the Plans and as specified herein. Provide NEMA 1 or NEMA 12 painted steel enclosures adequately sized for the cutouts and cables with hinged cover and back panel to mount the plug cutouts."

### 109-3.13 DUCT AND CONDUIT. Add the following to this section:

- "A. Conduit shall be installed in accordance with the following:
  - 1. All service, feeder, branch circuit, and control circuit conduits shall be galvanized rigid steel conduit.
  - 2. Schedule 40 PVC conduits shall be used for individual grounding electrode conductors and/or or bonding jumpers.
  - 3. Liquid-tight, flexible metal conduit shall be used as specified herein.
- B. Conduit Runs
  - 1. All conduits shall be sized, as indicated on the Drawings, or if conduit sizes are not shown, shall be in accordance with the NEC. All conduit systems shall be mechanically and electrically continuous from source of current to all outlets and grounded in accordance with the NEC.
  - 2. Run all exposed conduit parallel to building walls using right-angle bends. Exposed diagonal runs of conduit will not be permitted. Do not install conduit on roof surfaces, unless specifically indicated on the Drawings.
  - 3. Ream conduit after threads are cut. Cut ends square, and butt solidly into couplings.
  - 4. Prevent the accumulation of water, foreign matter, or concrete in the conduits during the execution of the work. Temporarily plug conduit, blowout, and swab before wires are pulled.
  - 5. Fasten conduits to all sheet metal boxes and cabinets with two locknuts, in accord with NEC, where insulated bushings are used and where bushings cannot be brought into firm contact with the

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- metal enclosures; otherwise, use at least a single locknut and bushing.
6. Provide conduit expansion joints at building expansion joints for conduit runs 1½ in. and larger. Provide conduit expansion joints or flexible conduit connection at building expansion joints for conduits less than 1½ in.
  7. Seal each underground joint and make water-tight.
  8. Where building construction or other conditions make it impossible to use standard threaded couplings, install water-tight, threaded unions.
  9. Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with conduit bending machine to avoid changing the internal diameter of the conduit and not damage it's protective coating, either inside or outside. Individual bends shall not exceed 90 degrees, and not more than 270 degrees total bends will be allowed in any one conduit run. Where more bends are necessary, and conduit runs exceed 150 lin. ft, install a suitable pull box or junction box.
  10. Provide empty conduits installed with a pull wire. Pull wire shall be No. 14 AWG zinc-coated steel or of plastic having not less than 200-lb. tensile strength. Leave not less than 12 in. of slack at each end of the pull wire.
  11. Use liquid-tight, flexible metal conduit for final connection to motors, constant current regulators, transformers, portable equipment, and for equipment subject to vibration and noise transmission. For each conduit sizes up to 1-in. trade size, flexible conduit shall be minimum length of 12 in., and a maximum length of 36 in. For conduit sizes above 1-in. trade size, flexible conduit shall be minimum length of 20 in., and maximum length of 48 in. Liquid-tight, flexible metal conduit shall be UL-listed and suitable for grounding. Liquid-tight, flexible metal conduit that is used for flexibility, including connections to motors, constant current regulators, and transformers, shall require an external bonding jumper or internal equipment grounding conductor per NEC 350.60. Do not install liquid-tight, flexible metal conduit that is not UL-listed.

C. Raceway Support and Hangers:

1. Securely fasten raceways in-place and support from ceiling or walls at spacing not exceeding:

	<u>Material</u> <u>Supports</u>	<u>Maximum Spacing of</u>
a.	½-in. thru 1-in. trade size conduit	6 ft

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- |    |                                       |       |
|----|---------------------------------------|-------|
| b. | 1¼-in. thru 1½-in. trade size conduit | 8 ft  |
| c. | 2-in. to 4-in. trade size conduit     | 10 ft |
| d. | Liquid-tight, flexible metal conduit  | 4½ ft |
| e. | Metal wireway                         | 10 ft |
2. Support rigid conduits within 3 ft of every outlet box, junction box, pull box, cabinet, or termination. Support flexible conduit within 12 in. on each side of every outlet box or fitting.
  3. Support conduits by pipe straps, wall brackets, hangers, or ceiling trapeze. The use of perforated iron or wire for supporting conduits is prohibited. Fasten with wood screws or screw nails to wood; by toggle bolts on hollow masonry units, by concrete inserts, or expansion bolts on concrete or spring-tension, or threaded C-clamps for rigid steel conduits on steel. Do not weld conduits or pipe straps to steel structures, unless specifically indicated.
  4. The load applied to fasteners shall not exceed one-third the proof test load of the fasteners.
  5. Fasteners attached to concrete shall be vibration-resistant and shock-resistant.
  6. Where two or more conduits 1-in. trade size or larger run parallel, trapeze hangers may be used consisting of threaded solid rods, washers, nuts, and galvanized "L" angle or channel iron. Individually fasten conduits to the cross member of every other trapeze hanger, with one-hole straps or clamp backs with proper size bolts, washers, and nuts. When adjustable trapeze hangers are used, use U-bolt type clamps at end of conduit runs, at each elbow, and at each third intermediate hanger to fasten each conduit.
  7. Make hangers of durable materials suitable for the application involved. Applied loads shall not exceed one-third of their loading capacity.
  8. All screws, bolts, washers, and miscellaneous hardware used for conduit supports shall be fabricated from rust-resisting metal. Trapeze hangers shall have hanger assemblies protected with galvanized finish."

109-3.15 WIRING AND CONNECTIONS. Add the following to this section.

"Low-voltage wiring shall maintain separation from high-voltage wiring. Low-voltage and high-voltage wiring shall not be installed in the same raceway. Low-voltage and high-voltage wiring shall not be installed in the same handhole or junction box."

109-3.16 MARKING AND LABELING. Add the following to this section:

"C. Legend plates shall be provided for all equipment. Legend plates shall be provided to identify the equipment controlled, the power source, and the

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function of each device. Legend plates shall be weather-proof, abrasion-resistant, phenolic/plastic, engraved material and fastened with contact-type permanent adhesive, screws, or rivets. Installation shall not break, crack, or deform the legend plate. Lettering shall be ¼ in. high, black on a white background, unless noted otherwise.

- D. Identify control wiring at each termination point and in junction/terminal boxes with wire number corresponding to the respective control wiring diagram or respective terminal numbering arrangement. Each individual control wire shall have unique identification, and shall maintain that same identification from its point of origin to its final termination point. Wire markers shall be permanent pressure-sensitive label, with suitable numbers or letters for easy recognition. Where new control wiring is interfaced to existing control wiring, it shall also match the color-coding of the existing control wiring.
- E. Color-code phase and neutral conductor insulation for No. 6 AWG or smaller. Provide colored marking tape for phase and neutral conductors for No. 4 AWG and larger. **Insulated ground conductors shall have green colored insulation for all conductor sizes (AWG and/or KCMIL) to comply with NEC 250.119. Neutral conductors shall have white colored insulation for No. 6 AWG and smaller to meet the requirements of NEC 200.6.** Standard colors for power wiring and branch circuits for 120/240 VAC, 1-Phase, 3-Wire system shall be Phase A – Black, Phase B – Red, Neutral – White, and Ground – Green.
- F. Furnish and install weather-proof warning label for each meter socket, enclosed circuit breaker, disconnect switch, switchboard, panelboard, load center, motor control center, and control panel to warn persons of potential electric arc flash hazards, per the requirements of NEC 110.16 “Flash Protection”. Labels shall also conform to ANSI Z535.4-2002 “American National Standard for Product Safety Signs and Labels”. NEC 110.16 requires that switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized shall be field-marked to warn qualified persons of potential arc flash hazards. The markings shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment. This new requirement is intended to help reduce the occurrence of serious injury or death due to arcing faults to those working on or near energized electrical equipment. The warning labels are to indicate to a qualified worker who intends to open the equipment for analysis of work that a serious hazard exists and that the worker should follow appropriate work practices and wear appropriate personal protective equipment (PPE) for the specific hazard. Labels shall be as detailed on the Plans or shall include at least the following information:



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“Warning - Potential Arc-Flash Hazards exist while working on this energized equipment. Appropriate PPE Required.”

109-3.17 EXISTING EQUIPMENT RELOCATIONS AND REMOVALS. Add the following:

“The Contractor shall relocate existing equipment where detailed on the Plans and/or where necessary to accommodate new work and installations. The Contractor shall be held responsible for any damage to existing equipment cause by the relocation and shall repair such damage immediately to the satisfaction of the Engineer at no cost to the Contract. The Contractor shall disconnect and remove the existing 120/240 VAC electric service equipment upon completion and activation of the new electric service to the Airport Electrical Vault. The Contractor shall provide temporary power and connections to maintain the operation of the lighting systems for the active runways and taxiways. Closure of a runway or taxiway must be coordinated with and approved by the Airport Director prior to proceeding with the respective closure.”

109-3.18 TESTING. The installation shall be tested in operation and as a completed unit prior to acceptance. Contractor shall furnish all equipment, meters, instruments, cable connections, tools, manpower, and labor to perform the respective tests. Test all new equipment and all existing equipment where modifications take place and confirm proper operation. Coordinate tests with the respective Airport personnel and the Resident Engineer. Tests shall include resistance, voltage, and current reading, as applicable, for the respective equipment. When tests disclose any unsatisfactory workmanship or equipment furnished under this Contract, correct defects and retest. Repeat tests until satisfactory results are obtained. When any wiring or equipment is damaged by tests, the wiring or equipment shall be repaired or replaced at no additional cost to the Contract. Test repaired or replaced items to ensure satisfactory operation. Submit three copies of all test reports to the Resident Engineer. All test reports shall be assembled and bound in a folder or binder. Each test report shall include the following information:

- Project number,
- Project title and location,
- Device or system tested,
- Test performed,
- Date performed,
- Test equipment used,
- Respective Contractor’s name, address, and telephone number,
- Testing firm’s name, address, and telephone number, if other than the Contractor,
- Names of individuals performing tests,
- Names of individuals observing tests,
- Statement verifying each test,
- Name plate data from respective equipment tested,
- Test results, and

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- Retest results after correction of defective components or systems, where applicable.

109-3.19 GROUNDING REQUIREMENTS. Grounding shall conform to the following: The Contractor shall furnish and install all grounding shown on the Plans, as specified herein, and in conformance with latest NFPA 70 – National Electrical Code (NEC) in force in order to make a complete grounding system. The reliability of the grounding system is dependent on careful, proper installation, and choice of materials. Improper preparation of surfaces to be joined to make an electrical path, loose joints, or corrosion can introduce impedance that will seriously impair the ability of the ground path to protect personnel and equipment and to absorb transients that can cause noise in communications circuits. The following functions are particularly important to ensure a reliable ground system:

- A. All products associated with the grounding system shall be UL-listed and labeled.
- B. All bolted or mechanical connections shall be coated with a corrosion-preventative compound before joining, Sanchem Inc. “NO-OX-ID “A-Special” compound, Burndy Penetrox E, or equal.
- C. Metallic surfaces to be joined shall be prepared by the removal of all non-conductive material, per 2008 NEC, Article 250-12. All copper bus bars must be cleaned prior to making connections to remove surface oxidation.
- D. Metallic raceway fittings shall be made up tight to provide a permanent low impedance path for all circuits. Metal conduit terminations in enclosures shall be bonded to the enclosure with UL-listed fittings suitable for grounding. Provide grounding bushings with bonding jumpers (from bushing to the respective ground connection/enclosure frame) for all metal conduits entering service equipment (meter bases, CT cabinet, service disconnects, service panelboards, main service breaker enclosure, etc.). Provide grounding bushings with bonding jumpers for all metal conduits entering an enclosure through concentric or eccentric knockouts that are punched or otherwise formed so as to impair the electrical connection to ground. Standard locknuts or bushings shall not be the sole means for bonding where a conduit enters an enclosure through a concentric or eccentric knockout.
- E. Furnish and install ground rings, ground fields, and/or ground rods at all locations, where shown on the Plans or specified herein. Ground rods shall be ¾ in. diameter, 10 ft long, UL-listed, copper-clad with 10-mil. minimum copper coating. Top of ground rods shall be a minimum of 30 in. below finish grade, unless otherwise noted on the Plans. Ground rods shall be spaced, as detailed on the Plans, and in no case spaced less than one-rod length apart. All connections to ground rods and/or ground rings shall be made with exothermic-weld-type connectors, Cadweld by Erico Products, Inc., Solon, Ohio, Phone: 800-248-9353, Thermoweld by Continental Industries, Inc., Tulsa, Oklahoma, Phone: 918-663-1440, or Ultraweld by Harger

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Lightning Protection Grounding Equipment, Grayslake, Illinois, Phone: 800-842-7437, or approved equal. Exothermic-weld connections shall be installed in conformance with the respective manufacturer's directions using molds, as required, for each respective application. Bolted connections will not be permitted at ground rods or at buried grounding electrode conductors. Grounding electrode conductors shall be bare-stranded copper sized, as detailed on the Plans. In addition to the grounding work described herein and shown on the Plans, the Contractor shall test the made electrode ground field/ground ring with an instrument specifically designed for testing ground field systems. If ground resistance exceeds **10 Ohms**, contact the Resident Engineer for further direction. Copies of ground field test results shall be furnished to the Resident Engineer, upon request, for review and record purposes.

- F. Buried or concealed ground systems shall be observed by the Resident Engineer before backfilling or covering.
- G. All connections located above grade between the different types of grounding conductors shall be made using UL-listed, double-compression, crimp-type connectors or UL-listed, bolted ground connectors. For ground connections to enclosures, cases, and frames of electrical equipment not supplied with ground lugs, the Contractor shall drill required holes for mounting a bolted ground connector. All bolted ground connectors shall be Burndy, Thomas and Betts, or equal. Tighten connections to comply with tightening torques in UL Standard 486A to assure permanent and effective grounding.
- H. All metal equipment enclosures, conduits, cabinets, boxes, receptacles, etc. shall be bonded to the respective grounding system.
- I. Each feeder circuit and/or branch circuit shall include an equipment ground wire. Metal raceway or conduit shall not meet this requirement. The equipment ground wire from equipment shall not be smaller than allowed by 2008 NEC Table 250-122 "Minimum Size Conductors or Grounding Raceway and Equipment." When conductors are adjusted in size to compensate for voltage drop, equipment-grounding conductors shall be adjusted proportionately according to circular mil area. All equipment ground wires shall be copper, either bare or insulated, and green in color. Where the equipment grounding conductors are insulated, they shall be identified by the color green, and shall be the same insulation type as the phase conductors.
- J. All utility transformer bank grounds shall be installed in accordance with the serving utility company's requirements and recommendations and in accordance with NEC.
- K. Bond the main electrical service neutral to ground at the main service disconnect. Bond the service neutral to ground at one location only per the NEC. A grounding connection shall not be made to any neutral circuit conductor on the load side of the service disconnecting means, except as permitted by the 2008 NEC, Article 250-24. Where the Contractor is unable to distinguish the difference between a neutral

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conductor and equipment grounding conductor, or other ground conductor, contact the Resident Engineer for assistance from the Project Engineer.

- L. The secondary neutral of all transformers (separately derived system transformers) shall be grounded in accordance with the NEC. The respective grounding electrode conductor shall be connected to the neutral point of the transformer between the transformer and the output disconnect means. Size of the grounding electrode conductor shall be in accordance with the 2008 NEC, Article 250-66 and Table 250-66, unless shown larger on the Drawings. A bond shall be provided between the neutral and transformer case, or other metal that is part of the AC equipment grounding system, so as to complete a circuit for fault current to the transformer winding from the AC equipment grounding system. Size of the neutral bonding conductor shall be in accordance with the 2008 NEC, Article 250-102.
- M. All exterior metal conduits, where not electrically continuous because of manholes, handholes, non-metallic junction boxes, etc., shall be bonded to all other metal conduit in the respective duct run and at each end with a copper-bonding jumper sized in conformance with the 2008 NEC, Article 250-102. Where metal conduits terminate in an enclosure (such as a motor control center, switchboard, etc) where there is not electrical continuity with the conduit and the respective enclosure, provide a bonding jumper from the respective enclosure ground bus to the conduit sized per the 2008 NEC, Article 250-102.
- N. Install grounding electrode conductors and/or individual ground conductors in Schedule 40 or Schedule 80 PVC conduit. Where grounding electrode conductors or individual ground conductors are run in PVC conduit, do not completely encircle conduit with ferrous and/or magnetic materials. Use non-metallic, reinforced, fiberglass strut support. Where metal conduit clamps are installed, use nylon bolts, nuts, washers, and spacers to interrupt a complete metallic path from encircling the conduit.
- O. Individual ground conductors and/or grounding electrode conductors shall not be run in metallic conduit and shall not be encircled by metallic clamps. If local codes dictate that grounding conductors must be run in metal conduit or raceway, then the conduit or raceway must be bonded to the grounding conductor at both ends with a bonding jumper sized in accordance with the NEC 250.64(E). All such installations requiring individual grounding conduits to be run in metal conduit or raceway shall be verified and reviewed with the Resident Engineer. This does not apply to AC equipment ground wires run with AC circuits.

### **METHOD OF MEASUREMENT**

109-4.3. Add the following to this section:

## ADDENDUM NO. 2

“The quantity of vault equipment to be paid for under Item AR109200, Install Electrical Equipment, shall consist of furnishing and installing all electrical equipment at the vault, as detailed on the Plans and specified herein. This Item shall include all labor, equipment, materials, conductors, connectors, conduits, wireways, terminal panels, core drilling, tools, operational instructions, coordination, labeling, and testing required to place the vault and associated electrical equipment into proper working order. Conduits between the vault and handholes located near the vault shall be considered incidental to this Item, and no additional compensation will be allowed.”

109-4.4. The quantity of the Generator System to be paid for under Item AR109800 “Generator System” shall consist of the portable generator quick connect, the automatic transfer switch, and the feeder conductors and conduits between the portable generator quick connect and the automatic transfer switch, installed, connected, tested, and accepted as a complete unit ready for operation.

109-4.5. The quantity of Remove Electrical Equipment to be paid for under Item AR109902, Remove Electrical Equipment, shall consist of the removal of the existing 2400 VAC electric service from the point of connection to the respective electric utility lines to the respective equipment in the vault. This shall include removal and disposal of the pothead and transformer or regulator located in the vault and all associated conduits, wiring, connection, fuses, fuse holders, supports, plywood, and materials. This item shall include all labor, tools, coordination, utility coordination, and incidentals required to remove the 2400 VAC service at the vault to the satisfaction of the Owner and Engineer.

109-4.6. The quantity of the electric service replacement for the Runway 30L VASI/PAPI system to be paid for under Item AR109924, Replace Electric Services shall consist of removing and replacing the respective service disconnect for the Runway 30L VASI system. This service will be used to power the Runway 30L PAPI system that will replace the existing Runway 30L VASI System. This item shall include replacing the respective service conductors and conduit from the existing meter base to the new disconnect equipment, and replacing the existing grounding system as detailed on the Plans and specified herein. This item shall include all labor, equipment, wiring, raceways, grounding, materials, tools, utility coordination, labeling, testing and all incidentals required to remove and replace the respective electric service installation to the satisfaction of the serving electric utility, Owner and Engineer.

### **BASIS OF PAYMENT**

Payment will be made under:

Item AR109200 Install Electrical Equipment - per lump sum  
Item AR109800 Generator System - per lump sum  
Item AR109902 Remove Electrical Equipment - per lump sum  
Item AR109924 Replace Electric Services - per lump sum