

ITEM M-008 APRON LIGHTING

CONTRACT DOCUMENTS

008-0.1 This section of these Specifications is a part of the Contract Documents as defined in the General Provisions. All applicable parts of the balance of the Contract Documents are equally as binding for this section as for all other sections.

Attention shall be directed to section M-001 of these Specifications entitled "Summary of Work and Special Work Requirements."

DESCRIPTION

008-1.1 This item shall consist of the installation of four (4) new thirty-five (35) foot poles, with fixtures (to be supplied by the Contractor). Each light pole will have an electrical junction can installed adjacent to the base.

The work shall include but not be limited to excavation for new light pole foundations, constructing new light pole foundations, furnishing a pole and fixtures, installing new poles and fixtures, installation of electrical junction cans, all wiring from the junction cans to the fixtures, aiming the fixtures, apron lighting control system, switches, breakers, duct and conduit, connections, terminations, grounding, and all incidentals necessary to place the apron lighting in operation as a completed unit to the satisfaction of the Engineer.

Item L-110 Ducts, Item L-108 Cables, and Item L-115 Hand Holes and Junction Cans shall be measured and paid for separately from the Hand Hole at the new electrical vault, to the Junction Can at the base of each light pole, all other equipment, materials, and labor shall be considered incidental to Item No. M-008-1

EQUIPMENT AND MATERIALS

008-2.1 GENERAL REQUIREMENTS. All materials, devices, and equipment, shall be new. Equipment and materials not specified herein should be furnished and installed in accordance with Sections L-108, L-109, and L-110 as well as the National Electrical Code.

008-2.2 IDENTIFICATIONS. All materials shall bear UL labels where such have been established for the particular device. All fixtures shall show make, type, serial number (where applicable), voltage ratings, and all other pertinent data. All wires shall have make, type of insulation, size, and voltage rating clearly marked upon it.

008-2.3 CONDUITS AND DUCTS. Exterior conduits and ducts shall be as specified in Specifications section L-110 Airport Underground Electrical Duct Banks and Conduits.

008-2.4 WIRE AND CABLE. Wire and cable shall be as specified in Specifications section L-108 Underground Power Cable for Airports.

008-2.5 JUNCTION CANS. Junction cans shall conform to the requirements of Specifications Section L-115 Junction Cans.

008-2.6 WIRE CONNECTORS AND DEVICES.

- A. All wire joints shall be made with a pressure squeezed connector such as T & G Stakon and Ideal, or bolted clamp such as made by Dessert. Twist-on type wire nuts are also permitted for general lighting circuits in dry locations only. Make up to terminals shall be mechanical squeeze connector. Wherever only a screw connector is available, a conductor terminal such as T & G Stakon spade or donut, designed for the application and compression set to the conductor shall be installed.
- B. All joints made shall be covered with non-insulated clamp devices with Scotch brand plastic electrical tape. Type #88 may be used at any joint and shall be used whenever the temperature of joint, or the room, is below 50°F; in the summer; when the temperature is above 60°F, new type #33 plus may be used. Each joint shall be triple wrapped, each wrap having a 50% overlay.

008-2.7 POLE AND LIGHTING FIXTURES.

- A. Light fixtures and poles shall conform to the fixture specification and description provided herein. Alternative fixtures may be proposed for the project where they provide the equivalent characteristics, quality, and appearance, subject to approval by the Engineer and the Owner. The proposed lighting fixture point-by-point print out with light levels noted on ten foot by ten foot grids shall be provided with complete photometric data and fixture cuts for approval on any substitute units.
- B. The following descriptive detail is provided to supplement pole, fixture and appurtenant components noted on the fixture schedule below:
- New Apron Light Fixture shall be a Holophane Medium Predator, 400 Watt Pulse Metal Halide, Energy Saving, Mogul Base, Multitap Wired for 208 Volt, UL Wet Locations listed, Spot distribution., Stainless yoke, Black Finish, Black Top Visor, Double fusing Fusekit, with Sylvania (M400/PS/U) 400MH Clear Mogul Base "E" Pulse Start Lamp, Model No. **PF40LPMMTKS3KF-F2 S-64321** or approved equal. Sixteen lights shall be provided (four on each pole). Each light shall include a Model No. **08657-BK** Mounting adapter, yoke to 2" slip fitter, cast aluminum, painted black.
 - The pole shall be designed for 100 mph winds with fixture. The pole height shall be thirty-five (35) feet. The pole shall have a cast aluminum anchor plate. The pole shall be compatible with the specified light fixture. Anchor bolts shall be provided per the manufacturer's recommendation. The pole shall be a Holophane 35' Sitelink T3 pole with hand hole, a P4 tenon and provisions for a GFCI outlet with location TBD at release of the order. Pole sized to hold (4) PF luminaires on a 4U bullhorn. Finish to be powder coat Holophane Black paint Model No. (STL561)SLT33500D1P4-SPCL with a standard pole kit for the above T3 pole with hand hole cover, nut covers and hardware as required. Finish to be powder coat Holophane Black paint. Model No. (STL561)SLT3POLEKITD1P4, a Duplex "Not In Use" style cover & 120 volt, 20 amp GFCI outlet. Finish to be powder coat Holophane Black paint, Model No. (STL561)SLOUTLT011220D1, a set of Anchor Bolts 1.25" X 42.00" +6.00", Model No. AB-28-4, and a 4U bullhorn to slip a P4 pole

top tenon. Finish to be powder coat Holophane Black paint, Model No. BR-945-BK., or approved equal.

008-2.8 DELIVERY, STORAGE AND PROTECTION.

- A. The Subcontractor shall be responsible for the work and equipment until finally inspected, tested and accepted. Materials and equipment which are not immediately installed after delivery to the site shall be carefully stored. Open ends of work shall be closed with temporary covers or plugs during construction, to prevent entry of obstructing material.
- B. Each Subcontractor shall protect work and material of other trades from damage that might be caused by that Subcontractor's work or workers and shall make good on damage thus caused.

008-2.9 CONCRETE, REINFORCING STEEL AND FORMS. Concrete, reinforcing steel and forms shall be as specified in Specifications section P-610 Structural Portland Cement Concrete.

008-2.10 LIGHTING CONTROL SYSTEM. The Apron Lights shall be controlled by a control system that is furnished and installed in the electrical vault by the Contractor in accordance with the details as shown on the Plans. The Lighting Control System shall operate as follows:

- The Lighting Control System (LCS) shall have a time clock (battery power 100 hour carryover, seven day with 365 day calendar and automatic daylight savings time, leap year, etc. corrections) that prevents the lights from turning on.
- The LCS shall have a photocell (mounted on the exterior of the electrical vault) that, when selected, will turn the lights on at dusk and off at dawn.
- The LCS shall have an "Apron Lights" momentary contact switch (prominently mounted on the exterior of the vault and labeled "Apron Lights") that, when pressed, turns on the Apron Lights for a period determined by a settable time delay relay (variable from 1 minute to 60 minutes).

The lighting control system shall be mounted in one area of the vault with each component labeled and a wiring diagram attached to the wall in a clear plastic sleeve.

008-2.11 SUBMITTALS. The Contractor shall submit a manufacturer's shop drawing for the light fixture, light pole, lighting control system and components, pull boxes, and ancillary components. A certification of compliance shall be provided for the concrete and reinforcing steel.

CONSTRUCTION METHODS

008-3.1 INSTALLATION. The light pole and fixture assembly shall be installed as detailed on the Plans, as recommended by the manufacturer, and as directed by the Engineer. In areas of conflict the more stringent shall apply. The pole shall be installed within 2 degrees of vertical.

008-3.2 POLE FOUNDATION. The Contractor shall furnish and install new light pole foundations.

New pole foundations shall be formed, using a SONO-TUBE or other approved form. The form shall extend a minimum of half the distance down the footing hole. The remaining portion can be earth formed if existing conditions permit. Reinforcing steel and conduits shall be placed in the form and reviewed by the Engineer prior to pouring the concrete. Concrete shall be cast and cured in accordance with Specifications section P-610 Structural Portland Cement Concrete. The concrete form shall be removed to a depth of one (1) foot below finished grade at the location of the pole foundation. The foundation shall have all conduits for power, ground, and control (if needed) cast into the foundation.

008-3.3 POLE ERECTION. The Contractor shall erect the pole on the foundation following the manufacturer's requirements and erection details. The pole shall be level and secure. The pole shall be installed within 2 degrees of vertical.

008-3.4 FIXTURE INSTALLATION AND AIMING. The Contractor shall install the light fixtures as recommended by the manufacturer. The light fixtures shall be aimed to prevent unwarranted glare in the Air Traffic Control Tower (ATCT) and provide optimum light levels on the apron. To accomplish this task, the fixtures shall be aimed at night during a period of complete darkness, at a time when the Airport Manager and ATCT personnel can approve the positioning of the light fixture.

008-3.5 ELECTRICAL CONNECTION. The Contractor shall furnish all labor and materials and shall make complete electrical connections in accordance with the wiring diagram furnished with the Plans. The electrical installation shall conform to the requirements of the latest edition of National Fire Protection Association, NFPA-70, National Electric Code.

008-3.6 GROUND CONNECTION AND GROUND ROD. The Contractor shall ground all fixtures, poles and materials in accordance with the latest requirements of the National Electric Code.

06-3.7 BALANCING, TESTING AND INSTRUCTION. The Contractor shall make all necessary adjustments to properly balance and place into operation the apron lighting system. The Contractor shall provide instruction to Airport Maintenance personnel on the operation and maintenance requirements of the apron lights, including the proper procedure required to change the fixture lamps.

METHOD OF MEASUREMENT

008-4.1 APRON LIGHT POLE AND FIXTURE. The quantity of Apron Light Poles and Fixtures shall be measured for payment per each light pole with fixtures installed, complete in accordance with the manufacturer's recommended installation procedures, the Plans, and as herein specified, including but not limited to excavation for new light pole foundation, constructing new light pole foundations, furnishing a pole and fixtures, installation of the pole and fixture, installation of electrical pull box, apron lighting control system, cable, switches, breakers, duct and conduit, connections, terminations, grounding, apron lighting in aiming the fixtures, and all incidentals necessary to place the new apron and operation as a completed unit to the satisfaction of the Engineer.

Item L-110 Ducts, Item L-108 Cables, and Item L-115 Hand Holes and Junction Cans shall be measured and paid for separately from the Hand Hole at the new electrical vault, to the Junction

Can at the base of each light pole, all other equipment, materials, and labor shall be considered incidental to Item No. M-008-1

BASIS OF PAYMENT

008-5.1 Payment will be made at the Contract unit price per each Apron Light Pole and Fixture installed, measured as specified above at which price and payment thereof shall constitute full compensation for all labor, materials, equipment, incidentals and expenses necessary to the satisfactory completion of the installation.

Payment will be made under:

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>UNIT</u>
M-008-1	Apron Light Pole and Fixture	Per Each

MATERIAL REQUIREMENTS

AC 150/5345-7	Specification for L-824 Underground Cable for Airport Lighting Circuits
AC 150/5345-27	Specification for Wind Cone Assemblies
FED SPEC TT-E-489	Enamel, Alkyd, Gloss, Low VOC Content
FED SPEC J-C-30	Cable and Wire, Electrical (Power, Fixed Installation) (cancelled; replaced by AA-59544 Cable and Wire, Electrical (Power, Fixed Installation))
FED SPEC W-P-115	Panel, Power Distribution
FED STD.595	Colors Used in Government Procurement
MIL-DTL-24441/20	Paint, Epoxy-Polyamide, Green Primer, Formula 150, Type III
Underwriters Laboratories	Rigid Metal Conduit Standard 6
Underwriters Laboratories Standard 514	Fittings For Conduit and Outlet Boxes
Underwriters Laboratories Standard 1242	Intermediate Metal Conduit
NFPA-70	National Electric Code
Master Painter's Institute	

END OF ITEM M-008

**ITEM M-009 ELECTRIFY INDIA RAMP
Additive Alternate No. 1.**

CONTRACT DOCUMENTS

009-0.1 This section of these Specifications is part of the Contract Documents as defined in the General Provisions. All applicable parts of the balance of the Contract Documents are equally as binding for this section as for all other sections.

Attention shall be directed to section M-001 of these Specifications entitled "Summary of Work and Special Work Requirements."

DESCRIPTION

009-1.1 The work under this section of these specifications shall consist of the installation of functional apron electrical outlets and installation of a new 100 ampere electrical distribution panel board. All work shall be done in accordance with all applicable codes, this specification, details shown on the plans, and as directed by the Engineer.

The Contractor shall provide a complete and working system acceptable to the Engineer. Materials required but not specified shall be compatible with the operation of the system, be heavy duty or industrial or commercial rated and be UL listed. All enclosures shall be NEMA 4XSS if available.

Work to be completed as part of this item include but are not limited to:

- Coordination with the electrical utility
- Installation of a new utility riser pole
- Establishment of a new 100 ampere electrical service in a stainless steel enclosure
- Installation of underground conduit
- Installation of conductor cables in new or existing ducts
- Installation of elevated apron outlets on existing light can bases
- Making all cable connections
- Other work as required to complete a working apron outlet electrical system.

All work shall be complete in accordance with all national and state codes, as specified herein, as shown on the plans and as directed by the Engineer.

No separate measurement for payment will be made for the separate elements of work as required to complete the apron outlets including but not limited to: all wiring, conduit, connections, service panels, disconnects, expansion fittings, outlets, enclosures, apron stanchion and other auxiliary work as required to have a complete and operating apron electrical outlet system.

All work completed as part of this effort will be considered part of Additive Alternate No. 1.

MATERIALS

009-2.1 GENERAL. Airport lighting equipment and materials covered by Federal Aviation Administration (FAA) specification numbers shall have the prior approval of the FAA and be listed in the FAA's latest listing of approved Airport "Lighting Equipment".

All other equipment and materials not covered by FAA specification numbers shall be subject to acceptance through manufacturer's Certification of Compliance with the applicable specification as described herein.

Equipment and materials not specified herein should be furnished and installed in accordance with Sections L-108, L-109, and L-110 as well as the National Electrical Code.

009-2.2 JUNCTION BOX. Junction boxes shall be watertight suitable for exterior use. Junction boxes shall be UL listed and IEC certified.

009-2.3 RECEPTACLES. Receptacles to be installed on the apron stanchion shall be enclosed in a water proof enclosure with cover. The receptacles shall be GFCI. The enclosure shall be aluminum and cover. Receptacles shall be UL listed and IEC certified. Other receptacles shall be as specified in Section L-109.

009-2.4 GFCI OUTLETS. Outlets shall be commercial grade, ground fault circuit interrupters, 2-pole, and 3-wire, rated for 120V 20 amp GFCI devices. GFCI outlets shall be UL listed.

009-2.5 FASTENERS AND HARDWARE. All fasteners and hardware shall be stainless steel unless otherwise shown or directed.

005-2.6 CABLE CONNECTORS. Cable connectors shall be suitable for direct burial and waterproof.

009-2.7 SHRINK WRAP. All connections shall be sealed with heat applied "shrink wrap" tubing as manufactured by Sigmaform Corporation, or an approved equal. See Plans for details.

009-2.8 GROUND RODS. Ground rods shall be copper-clad steel rods 3/4 inch in diameter and 10 feet long.

009-2.9 GROUND WIRE. Bare copper wire for grounding shall be as sized on the Plans conforming to ASTM Specification B 3 and B 8. If no size is indicated, the ground wire shall be #6.

009-2.10 TAPE. Tape for electrical connections shall be rubber and plastic Scotch Electrical Tape Number 23 and 88 by Minnesota Mining and Manufacturing Company, or an approved equal.

009-2.11 WIRE. Wire shall be as specified in Specifications section L-108.

009-2.12 ELECTRICAL SERVICE AND DISTRIBUTION SYSTEM. The power for the Apron Outlet System shall be taken from a new 100 amp electrical service mounted on a stanchion.

009-2.13 PANEL BOARD. Panel board shall be provided with main breaker, or main lugs, and branch circuit breakers according to the schedules on the Plans, or included in the Specifications.

Panel board shall be provided with a top-mounted main breaker or remote main breaker-to-panel main lugs and branch circuit breakers according to the schedule on the Plans. New panel boards shall be NEMA 4XSS enclosed, for exterior use, with a lockable door.

The general requirements for the panels, including mounting are shown on the Plans. The panel shall be mounted in accordance with applicable codes.

All breakers shall be trip-free, suitable for switching, and thermal magnetic. All breakers in panels shall be bolted to buss. "Space" means provisions for adding breakers. Breakers, or busses, shall contain terminations or tapings designed for these attachments. All points of contact between buss and sub-bus shall be copper, full silvered between all contact surfaces. All breakers shall have a minimum capacity of 22,000 amperes at 240 volts AC. Higher IC breakers shall be provided if local utility available fault current with panel board Shop Drawings.

A typewritten breaker panel legend shall be provided indicating fixture outlets, devices, machines, or apparatus served by each breaker and their location. This legend shall be labeled as shown on the Plans, with breakers numbered from top to bottom. The legend shall be mounted inside the door of the panel board in a transparent plastic cover.

For holding breakers in "ON" position, each panel board shall be provided with slip on screw set devices. These are to be used as described, to prohibit switching breakers unless clip is first removed. These devices shall not interfere with normal breaker tripping on overload conditions.

Built-in surge protection devices shall be provided at main electrical service panel.

009-2.14 OTHER ELECTRICAL EQUIPMENT. All other regularly used commercial items of electrical equipment not covered by FAA equipment specifications shall conform to the applicable rulings and standards of the Institute of Electrical Engineers or the National Electrical Manufacturers Association. When specified, test reports from a testing laboratory indicating that the equipment meets the specifications shall be supplied. In all cases, equipment shall be new and a first grade product. Where applicable, equipment and materials shall be UL listed for the intended use. This equipment shall be supplied in the quantities required for the specified project and shall incorporate the electrical and mechanical characteristics specified in the Proposal and Plans.

CONSTRUCTION METHODS

009-3.1 GENERAL. The Contractor shall furnish all materials to install elevated apron electrical outlets and new electrical services as shown on the Plans or as directed by the Engineer. The Contractor shall furnish, install and connect all specified equipment, equipment accessories, conduit, cables, wires, boxes, covers, grounds and support necessary to insure a complete and operable apron electrical outlet and electrical outlet system as specified herein and shown on the contract documents.

The installation includes complete installation in all respects, as shown on the Contract Drawings and/or as required to provide a fully functional system per the intent of the Contract Documents.

Each outlet/fixture shall be secure, and properly oriented as directed by the Engineer.

009-3.2 NEW ELECTRICAL DISTRIBUTION MODIFICATION. New panel board and conduit shall be field located as directed by the Engineer.

009-3.3 INSTALLING OF ELECTRICAL OUTLETS PVC RISER, AND OUTLET BOXES. PVC riser section, outlet boxes, and electrical junction boxes shall be installed as detailed on the contract plans and as directed by the Engineer. Sufficient slack shall be left in the cables to allow for the easy replacement of the riser section and outlets. All cables shall be neatly bundled, with wire ties and labeled.

The Contractor shall demonstrate to the Owner the process of removing the electrical outlets for the summer season. Sufficient cable slack shall be provided to allow the Owner to unplug the outlet at the pavement surface.

009-3.4 BALANCING OF LOADS. The Contractor shall balance all loads between phases in all panels, etc., around the neutral. Neutral conducts shall be the same size as phase conductors unless specifically noted otherwise.

All circuits shall be distributed among the phases so as to restrict any phase load imbalance to less than 10% at any panel board.

METHOD OF MEASUREMENT

009-4.1 The electrification of the India Ramp shall not be measured separately for payment but shall be measured as a single item including but not limited to furnishing and installing all equipment including elevated apron outlets, new panel, new utility pole, conduit, and wiring as required on the Plans and in this Specification and to install a complete operating system of outlets.

BASIS OF PAYMENT

009-5.1 Payment will be made at the Lump Sum Contract unit price for the electrification of the India Ramp as measured as specified above, which price and the payment thereof shall constitute full compensation for all labor, materials, equipment, incidentals and expenses necessary to complete the work.

Payment shall be made under:

<u>Item</u>	<u>Description</u>	<u>Unit</u>
M-009-1	Electrify India Ramp	Per Lump Sum

END OF ITEM M-009

**ITEM L-109 INSTALLATION OF AIRPORT TRANSFORMER VAULT
AND NEW RADIO AT AIR TRAFFIC CONTROL TOWER**

CONTRACT DOCUMENTS

109-0.1 This section of these specifications is a part of the Contract Documents as defined in the General Provisions. All applicable parts of the balance of the Contract Documents are equally as binding for this section as for all other sections.

Attention shall be directed to Section 1 of these specifications entitled "Summary of Work and Special Work Requirement."

DESCRIPTION

109-1.1 AIRPORT TRANSFORMER VAULT Installation of new precast concrete structure (transformer vault) including construction of new foundation for the vault, new concrete floor, furnishing and installing new precast structure, electrical service, new conduits and cables, grounding protection and miscellaneous hardware in accordance with the contract drawings, these specifications and all FAA Advisory Circulars and Orders. The construction of the airport transformer vault shall be in accordance with the design and dimensions shown on the plans. This work shall include the installation of conduits in floor and foundation, painting and lighting of the vault and the furnishing of all incidentals necessary to produce a completed unit.

109-1.2 VAULT EQUIPMENT This item shall consist of the furnishing of all vault equipment, electrical service, lighting fixtures and lamps, new regulator and relocation of one existing regulator, new L-854 radio for installation in air traffic control tower, apron lighting controls, wiring, panelboard, disconnect switches, conduit and grounding systems. This work shall also include the marking and labeling of equipment and the labeling or tagging of wiring; the testing of the installation; and the furnishing of all incidentals necessary to place it in operating condition as a completed unit to the satisfaction of the Engineer.

EQUIPMENT AND MATERIALS

109-2.1 GENERAL

a. Airport lighting equipment and materials covered by Federal Aviation Administration (FAA) specifications shall have the prior approval of the FAA, and are listed in Advisory Circular (AC) 150/5345-1, Approved Airport Equipment.

b. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when requested by the Engineer.

c. All existing equipment is removed from the existing vault under this project. All transformers, regulators, cutouts, etc., remain the property of the Owner and are to be relocated to an Owner-designated location within five miles of the vault. Contractor shall relocate, including loading and unloading.

109-2.2 TRANSFORMER VAULT. The following specifications are intended to describe the work to be performed and the quality of the work, but may not specifically cover all the details of

the work, equipment, accessories, and materials. They are, however, intended to cover the materials, equipment, apparatus, and erection of a complete structure whether specifically mentioned or not.

The transformer vault shelter shall be a new concrete precast building as manufactured by Concrete Systems, Inc., Hudson, NH, or approved equal. The 11'-6"W x 20'-0"L x 8'-10"H shelter shall be designed to meet all applicable building standards and installed according to the contract drawings and manufacturer's recommendations.

The shelter shall be equipped with the following: open fluorescent interior lights with RFI suppressors, heater, louvered vent with thermostat controlled fan, 70 watt high pressure sodium exterior light, lightning protection, air conditioning, surge protection, 3'0" x 7'0" exterior single door, interior insulation minimum R-14, interior plywood sheathing, and interior and exterior paint,.

Electrical panel for the new vault building shall be 400 amp, 208/120v, three phase, 4 wire.. Surge arrestors shall be approved equal to Surgellogic integral TVSS by Square D with UL suppression voltage rating (SVR) of 330 and line-to-line of 700 with a maximum continuous operating voltage of 150.

The Contractor shall construct a new foundation and concrete floor for the new vault building as indicated on the plans.

Provide installation, all terminations, grounding, testing, etc. to provide a fully connected and functioning installation.

Except as specified otherwise hereinafter, all work shall be done in accordance with the latest edition of the above referenced Advisory Circulars and Orders.

109-2.3 CONCRETE. Concrete shall be 4,000 psi.

109-2.3 REINFORCED STEEL. Reinforced steel bars shall be intermediate or structural grade deformed bars-type bars and shall meet the requirements of ASTM A 615

109-2.4 BRICK. Brick shall conform to ASTM C 62, Grade SW

109-2.5 PVC DUCT. Conduit below grade shall be schedule 40 High Density PE, suitable for underground use. Expansion couplings for direct buried conduit shall be "o" ring type PVC.

109-2.6 RIGID STEEL CONDUIT. Rigid steel conduit and fittings shall be in accordance with Underwriters Laboratories Standard 6 and 514

109-2.7 PAINT.

- a. Red lead priming paint for ungalvanized metal surface, and the mixing thereof, shall conform to the 975 grade specified in ASTM D 83. The red lead shall be furnished in paste form and delivered to the job in the original unbroken packages bearing the maker's name and brand.
- b. White paint for the body and finish coats on metal and wood surfaces shall be ready-mixed paint conforming to Fed. Spec. TT-P-102.
- c. Priming paint for wood surfaces shall be mixed on the job by thinning the above specified white paint by adding ½ pint(0.06 liter) of raw linseed oil to each

- gallon(liter).
- d. Paint for the floor, ceiling, and inside walls shall be in accordance with Fed. Spec. TT-E-487. Walls and ceiling shall be light gray and the floor shall be medium gray.
 - e. The roof coating shall be hot asphalt material in accordance with Fed. Spec. SS-A-694

109-2.8 VAULT EQUIPMENT. The following specifications are intended to describe the work to be performed and the quality of the work, but may not specifically cover all the details of the work, equipment, accessories, and materials. They are, however, intended to cover the materials, equipment, apparatus, and erection of a complete electrical system whether specifically mentioned or not.

109-2.9 GROUNDING. The grounding system shall comply with applicable local electrical code requirements of the authority having jurisdiction, and NEC as applicable to electrical grounding and bonding, pertaining to systems, circuits and equipment.

Comply with applicable requirements of UL Standards No.'s 467, "Electrical Grounding and Bonding Equipment", and 869 "Electrical Service Equipment", pertaining to grounding and bonding of systems, circuits and equipment. In addition, comply with UL STD 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors". Provide grounding and bonding products which are UL-listed and labeled for their intended usage.

Comply with applicable requirements and recommended installation practices of IEEE Standards 80, 81, 141 and 142 pertaining to grounding and bonding of systems, circuits and equipment.

Except as otherwise indicated, provide electrical grounding and bonding systems indicated; with assembly of materials, including, but not limited to, cables/wires, connectors, solderless lug terminals, grounding electrodes and plate electrodes, bonding jumper braid, and additional accessories needed for a complete installation. Where more than one type component product meets indicated requirements, selection is Installer's option. Where materials or components are not indicated, provide products which comply with NEC, UL, and IEEE requirements and with established industry standards for those applications indicated.

Unless otherwise indicated, provide electrical grounding conductors for grounding system connections that match power supply wiring materials and are sized according to NEC.

- a. Copper cable; strand dia. 0.045"; 0.187#/ft.; 57,400 circular mils.
- b. Copper solid strip; 0.051" thick; 1/2" wide.
- c. Copper solid rod; 0.187#/ft.
- d. Copper cable; strand dia. 0.045"; 14 strands.
- e. Copper bus; 0.250" thick; 3" wide.
- f. Copper solid rod; dia. 0.162".
- g. Bonding Jumper Braid: Copper braided tape, constructed of 30-gauge bare copper wires and properly sized for indicated applications.

h. Flexible Jumper Strap: Flexible flat conductor, 480 strands of 30-gauge bare copper wire; 3/4" wide, 9-1/2" long; 48,250 CM. Select braid with holes sized for 3/8" diameter bolts, and protect braid with copper bolt hole ends.

Ground Electrodes and Plates

a. Grounding Electrodes: Solid copper, 3/4" diameter by 10 feet.

b. Electrical Grounding Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing, welding materials, bonding straps, as recommended by accessories manufacturers for type service indicated.

c. Field Welding: Comply with AWS Code for procedures, appearance, and quality of welds; and for methods used in correcting welding work. Provide welded connections where grounding conductors connect to underground grounding and plate electrodes.

109-2.10 FAA-APPROVED EQUIPMENT. Certain items of airport lighting equipment installed in vaults are covered by individual FAA equipment specifications. The specifications are listed below.

AC 150/5345-7 Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits

AC 150/5345-10 Specification for Constant Current Regulators and Regulators Monitors

AC 150/5345-49A Specification for Radio Controllers

109-2.11 OTHER ELECTRICAL EQUIPMENT. Constant-current regulator, transformers, series plug cutout, panel boards, disconnect switches, relays, terminal blocks, circuit breakers, and all other regularly used commercial items of electrical equipment not covered by FAA equipment specifications shall conform to the applicable rulings and standards of the Institute of Electrical and Electronic Engineers or the National Electrical Manufacturers Association. When specified, test reports from a testing laboratory indicating that the equipment meets the specifications shall be supplied. In all cases, equipment shall be new and first-grade product. This equipment shall be supplied in the quantities required for the specific project and shall incorporate the electrical and mechanical characteristics specified in the proposal and plans.

109-2.12 WIRE. Wire in conduit rated 5,000 volts shall conform to AC 150/5345-7, Specification for L-824 Underground Electrical Cables for Airport Lighting Circuits. For ratings up to 600 volts, thermoplastic wire conforming to Fed. Spec. J-C-30, Type XHHW-2 shall be used where installed in conduits and/or wireways. The wires shall be of the type, size, number of conductors, and voltage shown in the plans or in the proposal. Wiring that is to be direct buried shall have an insulation system approved by the NEC for direct burial.

a. Control Circuits. Wire shall be not less than No. 12 AWG and shall be insulated for 600 volts. If telephone control cable is specified, No. 19 AWG telephone cable conforming to the United States Department of Agriculture, Rural Electrification Administration (REA) Bulletin 345-14 shall be used.

b. Power Circuits.

- (1) 600 volts maximum--Wire shall be No. 6 AWG or larger and insulated for at least 600 volts.
- (2) 3,000 volts maximum--Wire shall be No. 6 AWG or larger and insulated for at least 3,000 volts.
- (3) Over 3,000 volts--Wire shall be No. 6 AWG or larger and insulated for at least the circuit voltage. (Not including Type C, Specification L-824 Wire.)

109-2.13 PANELBOARDS. Manufacturers shall be regularly engaged in manufacture of panelboards and enclosures, of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

Installers shall have at least 3 years of successful installation experience on projects utilizing panelboards similar to those required for this project.

a. Codes and Standards

- (1) Comply with applicable local code requirements of the authority having jurisdiction and NEC Article 408 as applicable to installation, and construction of electrical panelboards and enclosures.
- (2) Comply with applicable requirements of UL 67, "Electric Panelboards", and UL's 50, 869, 486A, 486B, and 1053 pertaining to panelboards, accessories and enclosures. Provide panelboard units which are UL-listed and labeled.
- (3) Comply with NEMA Stds. Pub/No. 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)," Pub/No. PB 1, "Panelboards", and Pub/No. PB 1.1, "Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less".

Federal Specification Compliance: Comply with FS. W-P-115, "Power Distribution Panel", pertaining to panelboards and accessories.

Subject to compliance with requirements, provide panelboard products of one of the following (for each type and rating of panelboard and enclosure):

- a. Square D Company.
- b. General Electric Company.
- c. Cutler Hammer Company

Except as otherwise indicated, provide panelboards, enclosures and ancillary components, of types, sizes, and ratings indicated, which comply with manufacturer's standard materials; with the design and construction in accordance with published product information; equip with proper number of unit panelboard devices as required for complete installation. Where types, sizes, or ratings are not indicated, comply with NEC, UL and established industry standards for those applications indicated.

Power panelboards shall be dead-front safety type lighting and appliance panelboards as indicated, with switching and protective devices in quantities, ratings, types and arrangements shown; with anti-burn solderless pressure type lug connectors approved for use with copper conductors; construct unit for connecting feeders at top of panel; equip with copper bus bars, full-sized neutral bar, with bolt-in type heavy-duty, quick-make, quick-break, single-pole circuit-breakers, with toggle handles that indicate when tripped. Provide suitable lugs on neutral bus for each outgoing feeder required; and provide bare uninsulated grounding bars suitable for bolting to enclosures. Select enclosures fabricated by same manufacturer as panelboards, which mate and match properly with panelboards.

Panelboard enclosures shall be galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gauge, minimum 16-gauge thickness. Construct with multiple knockouts and wiring gutters. Provide fronts with adjustable trim clamps, and doors with flush locks and keys, all panelboard enclosures keyed alike, with concealed piano door hinges and door swings as indicated. Panelboards shall utilize "door-in-door" type fronts. Equip with interior circuit-directory frame, and card with clear plastic covering. Provide baked gray enamel finish over a rust inhibitor coating. Design enclosures for surface mounting. Provide enclosures which are fabricated by same manufacturer as panelboards, which mate and match properly with panelboards to be enclosed.

Molded-case circuit breakers shall be factory-assembled, molded-case circuit breakers of frame sizes, characteristics, and ratings including RMS symmetrical interrupting ratings indicated. Select breakers with permanent thermal and instantaneous magnetic trip, and with fault-current limiting protection, ampere ratings as indicated. Construct with overcenter, trip-free, toggle-type operating mechanisms with quick-make, quick-break action and positive handle trip indication. Construct breakers for mounting and operating in any physical position, and operating in an ambient temperature of 40 deg C. Provide breakers with mechanical screw type removable connector lugs, CU rated.

Minimum integrated short circuit rating - 22,000 amperes rms symmetrical @ 240 volts. Higher interrupting capacity rated breakers shall be provided if the available fault current exceeds 22,000 Amperes. This shall be at no added cost to the Owner. Provide calculated fault current with shop drawing submittal, or shop drawings will be returned without review or approval.

Provide built-in TVSS protection as described previously in this section, 109-2.2 and following in this section, 109-2.15.

109-2.14 RUNWAY 14-32 REGULATOR. The Runway 14-32 regulator shall be new, rated 20 kW, 208 volt, with 120 volt control power, primary switch and input and output lightning/surge arrestors and shall conform to requirements of FAA Specification L-828, and shall be new. The Regulator shall be as manufactured by Crouse-Hinds, dry type, 60 hertz, powered from 208 volt utility service, 6.6 ampere, 5 step, with digital display, or approved equal. Power from Panelboard "MDP". Provide new output wiring to new series plug cutout, Type S-1, Crouse-Hinds #30775, or approved equal. Provide new conduit for constant current output wiring from S-1 cutout to regulator. Provide conduit and control wires to connect to Owner's existing interface panel at the Air Traffic Control Tower and connect appropriately. New wiring from S-1 cutout to airfield lighting is under another pay item.

109-2.15 SURGE ARRESTOR. Provide high capacity 208/120 volt surge arrestors built into the main service panelboard. Unit shall be equivalent to "Surelogic" TVSS be Square D and shall

be rated not less than 320 kA per phase.

109-2.16 DISCONNECT (SAFETY) SWITCHES. Work specified in this section shall consist of furnishing and installing disconnect switches.

A. Disconnect switches shall be heavy duty type. The switches shall be quick-make, quick-break type that during normal operation of the switch, the operation of contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started. Provision for padlocking the switch in the "OFF" position with at least three locks shall be provided. Provide with grounding lug.

B. Switches shall have a dual cover interlock to prevent unauthorized opening of the switch door when the handle is in the "ON" position, and to prevent closing of the switch mechanism when the door is open. Means shall be provided to permit authorized personnel to release the interlock for inspection purposes. Fused switches shall utilize Class R fuse holders.

C. Switches shall be rated 3 pole, single-throw, 600 volts with ampere rating as shown on the Contract Drawings. The UL listed short-circuit rating of the switch shall be 200,000 rms symmetrical amperes when Class R or Class J fuses are used with the appropriate rejection scheme.

D. Enclosure shall be NEMA 1 enclosed where mounted inside vault area. Enclosure shall be NEMA 4X stainless steel if outdoors.

E. The finish shall be gray baked enamel, electrodeposited on clean phosphatized steel.

F. The switches shall conform to NEMA KS1 and UL 98.

109-2.17 WIRE CONNECTORS AND DEVICES. All wire joints shall be made with a pressure squeezed connector such as T & B Stakon and Ideal, or bolted clamp such as made by Dessert. Twist-on type wire nuts are also permitted for general lighting and receptacle circuits only and only in dry locations. Wherever only a screw connector is available, install a conductor terminal like T & B Stakon spade or donut and designed for the application and compression set to the conductor.

Cover all joints made with non-insulated clamp devices with Scotch brand plastic electrical tape. Type #88 may be used at any joint and shall be used whenever the temperature of joint or the room is below 50°F. In the summer, or when temperature is above 60°F, new type #33 plus may be used. Triple wrap joints, each wrap having a 50% overlay.

109-2.18 SECONDARY SERVICE. Electrical utility service shall be provided underground. Provide underground power conduit and wiring for service.

109-2.19 ELECTRICAL SERVICE AND DISTRIBUTION SYSTEM. The electric utility company shall provide the electrical service of the characteristics as shown on the drawings. The Subcontractor's work will begin where the utility company's work ends.

The Subcontractor shall furnish all labor, materials, etc., necessary for a complete approved electrical service as required by the structure, including inspection and approval by the utility and local inspection departments.

The Subcontractor shall notify the utility company in writing, with a copy to the Engineer, no later than ten days after signing construction contracts, as to when the power service will be required.

109-2.20 UNDERGROUND ELECTRICAL SERVICES. Underground service shall comply with all the requirements of the National Electrical Code, local utility company, and local enforcing authority.

Furnish and install secondary lugs on transformer as required. Secondary service shall be cable in rigid galvanized conduit. It may be run in schedule 40 PVC plastic conduit or rigid galvanized conduit approved for electrical use. Conduit shall be 36" below grade and pitched to drain.

Verify Service Conduit size requirements with the serving utility and provide conduit(s) that conform to their standards regardless of size(s) indicated on Contract Drawings.

Install yellow plastic marking tape 12" above underground wiring.

109-2.21 PRIMARY POWER SERVICE. Primary power modifications, if required, shall be included in the Scope of Work.

The Contractor shall pay in full for any and all primary power line extension/modification costs as charged by the local utility.

109-2.22 METERING. The service shall be metered.

The electrical Subcontractor shall furnish and install all equipment and meter trim for metering, in accordance with utility company requirements, except that the utility meter will be provided by the local utility.

Where the local utility does not provide the meter socket, the Electrical Subcontractor shall provide them to the local utility's specifications. The meter socket shall be placed adjacent to the two other meter sockets serving the ATCT and the adjacent hangar and shall be similar in color and appearance.

Any utility required metering transformer and/or cold meter disconnect (disconnect switch installed ahead of the utility meter) shall be provided by the Contractor to the specifications of the utility company.

Any utility charges for poles, transformers, service cable, meters, etc., in connection with the provision of the temporary (construction) power shall be paid in full by the Electrical Subcontractor under this Section; this does not include the cost of temporary power as covered elsewhere, it shall also include any cost of primary power modifications/extension to the site.

109-2.23 SWITCHES AND PLATES.

- A. Switches shall be specification grade, 20 amperes at 120/277 volts, with ivory handle, such as Hubbell 1221-I, for SPST applications. For three-way use, No. 1223-I. All switches shall have clamp type terminals screw set, and shall have a green ground bond screw.
- B. Mount all switches vertically, wall-flush, and at a height of 4' 0", adjusted to minimize cut of tile or masonry unit, unless otherwise specified.

- C. All switches must have machine screw held wire and be back wired. Automatic grips will not be permitted. All switches must be classed as heavy duty.
- D. All flush plates are to be ivory nylon plates, one piece construction. Plates on surface boxes shall match boxes.
- E. Switches and plates shall be a product of Bryant, General Electric or Hubbell.

109-2.24 CONVENIENCE AND OTHER OUTLETS AND PLATES

- A. Convenience outlets shall be duplex, specification grade, ivory face, side wired binding screw type, two pole, three wire, rated 20 amperes at 120 volts, Bryant 5362-I or equal. Use Bryant smooth nylon plates or equal. Mount all outlets a minimum of 24" AFF.
- B. Ground Fault Receptacles shall be Bryant GFR 82FT-I, NEMA 5-20R configuration. Each receptacle noted as "GFI" is an individually protected receptacle.
- C. Mount vertical outlets with grounding slot up. Outdoors and elsewhere as shown, use waterproof covers, Hubbell 5206 or equal, with double covers, spring held gasketed. Mount the outlet horizontally.
- D. Automatic grip set outlets are not permitted.
- E. On flush mounted boxes for concealed wiring, use ivory nylon plates. On exposed FS and FD boxes, use cast ferrous cover matching the box or stainless steel as above, if styled for the box. Outdoors and in damp locations, use weatherproof covers, Tay Mac, conforming to NEC 410-57b and U/L listed.
- F. Outlets and plates shall be a product of Bryant, General Electric or Hubbell.

109-2.25 LIGHTING FIXTURES

- A. Wire directly to an outlet box for each fixture in and on the building. General building wire is to be used to these outlets. From outlet into fixture, use silicone rubber, color coded to make up to fixture socket or ballast supply leads. And a bond wire to ground all fixtures.
- B. The lighting fixtures listed on the Drawings are to indicate quality, appearance, lamping and photometric characteristics acceptable. Alternative fixtures may be proposed for the project where they provide the equivalent characteristics, quality and appearance, and subject to Engineer approval.

109-2.26 LAMPS, BALLASTS AND ACCESSORIES

- A. Except as otherwise specified, all fluorescent ballasts are to be for rapid start lamps and power factor corrected to approximately 95% lagging. All ballasts shall carry E.T.L. approval, and where available in the type needed, shall carry an A sound rating. All ballasts shall be premium, low energy type approved equal to Advance full electronic, solid state type. Ballasts for high intensity discharge lighting shall have a crest factor of less than 1.7.
- B. Fluorescent lamp ballasts shall be so mounted as to avoid amplifying hum, and any ballast

which, within one year, develops a hum considered excessive by the Engineer, shall be replaced free of charge with another of a noise level considered satisfactory by the Engineer.

- C. All lamps shall be color and type specified. Incandescent lamps shall be for 125 volt service. They shall be the product of General Electric, Sylvania or Westinghouse, and be so labeled. Fluorescent lamps shall be low energy T-8 octron type, 3500° K color temperature.

109-2.27 FUSES (if any)

- A. Provide a complete set of fuses for each fusible switch. Time-current characteristics curves of fuses serving motors or connected in series with circuit breakers or other circuit protective devices shall be coordinated for proper operation; submit coordination data for approval. Fuses shall have a voltage rating not less than the circuit voltage.
- B. Cartridge Fuses, Current-limiting type (Class R): UL 198E, Class RK-1 time-delay type. Associated fuseholders shall be Class R only.

109-2.28 OUTLET BOXES

- A. For concealed wiring to wall switches and duplex outlets, use gaugeable steel boxes not less than 2 $\frac{3}{4}$ " deep, such as Raco 560 to 568 Series. These may have cable clamps or a connector added to them. Four-inch square or larger boxes with raised plaster rings are equally acceptable. These boxes may be directly nailed to a stud if they fall adjacent to one; otherwise, wood straps a minimum of 2 $\frac{1}{2}$ " x $\frac{3}{4}$ " between studs shall be added and mounting shall be by ears on the box. Solid or adjustable bar hangers are equally acceptable.
- B. Flush ceiling and device outlet boxes shall be 4" octagonal by 2 $\frac{1}{2}$ " deep or 4" square boxes with raised plaster rings.
- C. Set all flush boxes to have edge precisely in the same plane as the finished wall surfaces.
- D. All boxes shall be held to wood surfaces by wood screws. On metal surface, boxes shall be held by metal-to-metal screws or by machine bolts.
- E. Any outside boxes or interior boxes mounted exposed shall be cast metal type with integral threaded hubs, or where indicated as NEMA 4x shall be reinforced nonmetallic type with integral threaded hubs. Bell style boxes will not be accepted./

109-2.29 UNDERGROUND DUCTS – UTILITY POWER. Provide underground ducts and electrical manholes (if any) for utility power to new meter and with riser pole to new main disconnect. Ducts and manholes shall be in accordance with Item L-110 of these specifications.

109-2.30 RACEWAYS. Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

- a. Liquid-Tight Flexible Metal Conduit
- b. Rigid Metal Conduit

The extent of raceway work is indicated by drawings and schedules.

Manufacturers shall be firms regularly engaged in manufacture of raceway systems of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

Installers shall have at least 3 years of successful installation experience on projects with electrical raceway work similar to that required for this project.

Comply with applicable requirements of NEMA Standards Publications pertaining to raceways.

Comply with applicable requirements of UL safety standards pertaining to electrical raceway systems. Provide raceway products and components which have been UL-listed and labeled.

Comply with applicable requirements of NEC pertaining to construction and installation of raceway systems.

Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) for each service indicated. Where types and grades are not indicated, provide proper selection determined by Installer and approved by the Owner, to fulfill wiring requirements, and comply with applicable portions of NEC for raceways.

Provide rigid steel, zinc-coated, threaded type conforming to FS WW-C-581, ANSI C80.1 and UL 6. Zinc coating shall be fused to inside and outside walls.

Provide liquid-tight flexible metal conduit; constructed of single strip, flexible, continuous, interlocked, and double-wrapped steel; galvanized inside and outside; coat with liquid-tight jacket of flexible polyvinyl chloride (PVC).

Rigid metal conduit fittings shall be cast malleable iron, galvanized or cadmium plated, conforming to FS W-F-408.

- a. Use Type 1 fittings for raintight connections.
- b. Use Type 2 fittings for concrete tight connections.
- c. Use Type 3 fittings for other miscellaneous connections.

Liquid-tight flexible metal conduit fittings shall be FS W-F-406, Type 1, Class 3, Style G. Provide cadmium plated, malleable iron fittings with compression type steel ferrule and neoprene gasket sealing rings, with insulated, or non-insulated throat.

Provide conduit, tubing and duct accessories of types, sizes, and materials, complying with manufacturer's published product information, which mate and match conduit and tubing.

Provide galvanized cast-metal conduit bodies of types, shapes and sizes as required to fulfill job requirements and NEC requirements. Construct conduit bodies with threaded- conduit-entrance ends, removable covers, either cast or of galvanized steel, and corrosion-resistant screws.

Provide expansion fittings on all conduits that rise from below grade at the exterior of any building or other structure and elsewhere as required by the National Electrical Code.

Subject to compliance with requirements, provide conduit bodies of one of the following:

- a. Killark Electric Mfg. Co.
- b. O-Z/Gedney Div; General Signal Co.
- c. Spring City Electrical Mfg. Co.

109-2.31 WIREWAY (if any). Provide wireway in accordance with UL 870. Manufacture to JIC standards for Oiltight and Dustright Lay-in Wireway, and to NMTBA standards for industrial Control Equipment.

Lengths and Fittings: Manufacture from 14-gauge steel, provide straight lengths with hinged covers with gasketing. Hold covers closed with external latches. Installation of knockouts in either lengths or fittings are to be avoided.

Provide wireway that is suitable for "lay-in" conductors and with joint hardware assembly with each piece.

Provide sheet metal parts with inhibiting phosphate coating and baked enamel finish.

109-2.32 PULLBOXES (if any). Pullboxes shall comply with UL 50, "Electrical Cabinets and Boxes", for boxes over 100 cubic inches volumes. Boxes shall have screwed or bolted on covers of material same as box and shall be of size and shape to suit application.

Pullboxes shall be appropriate gauge steel with welded seams. Where necessary to provide a rigid assembly, construct with internal structural steel bracing.

109-2.33 MEDIUM VOLTAGE SPLICING (if any). All splicing shall comply with the following standards:

1. IEEE 48: "IEEE Standard Test Procedures and Requirements For High-Voltage Alternating Current Cable Terminations."
2. IEEE 400: "Guide For Making High-Direct-Voltage Tests on Power Cable Systems in the Field."
3. IEEE 404: "Standard For Power Cable Joints."
4. IEEE 592: "Standard For Exposed Semiconducting Shields on Premolded High-Voltage Cable Joints and Separable Insulated Connectors."
5. UL 486A: "Wire Connectors and Soldering Lugs for Use with Copper Conductors."
6. UL 486B: "Wire Connectors and Soldering Lugs for Use with Aluminum Conductors."

Splicing shall be compatible with the cable materials.

Connectors: Compression type as recommended by cable or splicing kit manufacturer for the application.

Splicing and Terminating Kits: As recommended by the manufacturer in writing for the specific sizes, ratings, and configurations of cable conductor, splices, and terminations specified. Kits shall contain all components required for a complete splice or termination including detailed instructions and shall be the product of a single manufacturer. Completed splices and terminations shall provide insulation equivalent to the insulation class of the cable it connects.

Splices shall be made with standard splicing kits and shall be one of the following types:

1. Combination tape and cold shrink rubber sleeve kit with re-jacketing by cast epoxy resin encasement or other waterproof, abrasion-resistant material.
2. Heat shrink splice kit of uniform cross-section polymeric construction with outer heat shrink jacket.
3. Remolded, cold shrink rubber, inline splice kit.

Conductor Terminations, General: Comply with Class 1, 2, or 3 of IEE Standard 48, as indicated. Insulation class shall be equivalent to that of the cable upon which they are installed. Terminations for shielded cables shall include a shield grounding strap. Class 2 terminations and non-shielded cable termination shall include an effective moisture seal for the end of the insulation whether or not this item is included in termination kits. Seal shall be silicone rubber tape, cold shrink rubber sleeve, or heat shrink plastic sleeve as recommended by the kit manufacturer. Termination kits shall be performance tested for compliance with IEEE Standard 48 and shall be of the following types:

1. Class 1 Termination for Shielded Cable: Modular type, furnished as a kit, with stress relief tube, multiple molded silicone rubber insulator modules, shield ground strap, and compression-type connector.
2. Class 1 Termination for Shielded Cable: Heat-shrinkable type with heat-shrinkable inner stress control and outer nontracking tubes, multiple molded nontracking skirt modules, and compression-type connector.
3. Class 1 Termination for Shielded Cable: Modular type, furnished as a kit, with stress-relieving shield terminator; multiple-wet-process, porcelain, insulator modules; shield ground strap compression-type connector.
4. Class 1 Termination for Indoor Shielded Cable: Furnished as a kit with stress relief tube, nontracking insulator tube, shield ground strap, compression-type connector, and end seal.
5. Class 2 Termination for Shielded Cable: Furnished as a kit with stress relief tube, nontracking insulator tube, shield ground strap, compression-type connector, and moisture end seal.
6. Termination for Non-shielded Cable: Furnished as a kit with compression-type connector and moisture end seal.

109-2.34 DESIGN CRITERIA. All lighting vault constant current regulator equipment sizes have been calculated based on the following loads.

- 1 module size 2, style 2 sign volt-amperes with isolation transformer = 193 VA.
- 2 module size 2, style 2 sign volt-amperes with isolation transformer = 346 VA.
- 3 module size 2, style 2 sign volt-amperes with isolation transformer = 387 VA.
- 4 module size 2, style 2 sign volt-amperes with isolation transformer = 554VA.
- Runway 120 watt edge light with isolation transformer = 160 VA.
- Runway 115 watt threshold light with isolation transformer = 150 VA.
- Taxiway 45 watt edge light with isolation transformer = 54.7 VA

Requests for review of substitute items of material and equipment requiring different design loads will not be accepted by the Owner from anyone other than the Contractor. If Contractor wishes to furnish or use a substitute item of material or equipment the Contractor shall make written application to the Owner for acceptance thereof, certifying that the proposed substitute will perform adequately the functions called for by the general design, be similar and of equal substance to that specified and be suited to the same use and capable of performing the same function as that specified. The application will state whether or not acceptance of the substitute for use in the Work will require a change in the Drawings or Specifications to adapt the design to the substitute and whether or not incorporation or use of the substitute in connection with the Work is subject to payment of any license fee or royalty. All variations of the proposed substitute from that specified shall be identified in the application and available maintenance, repair and replacement service will be indicated. The application will also contain an itemized estimate of all costs that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of other contractors affected by the resulting change, all of which shall be considered by the Owner in evaluating the proposed substitute. The Owner may require the Contractor to furnish at the Contractor's expense additional data about the proposed substitute. The Owner will be the sole judge of acceptability, and no substitute will be ordered or installed without the Owner's prior written acceptance. The Owner may require the Contractor to furnish at the Contractor's expense a special performance guarantee or other surety with respect to any substitute.

The Contractor's written application shall include the following:

- a. A statement that a clear superiority of the substitute item (over that specified) exists, supported by certified test results, performance data and other evidence to supplement the requirements of the General Conditions or
- b. If no superiority is claimed, the application shall also state the monetary credit to the Owner which will be allowed if the substitute item is accepted.

In order to aid the Owner in determining the equality of a proposed substitution (when compared to the item actually specified), the Contractor shall arrange for the performance of any tests requested by the Owner. The nature, extent, tester and supervisions of such tests including engineering costs, shall be borne by the Contractor. Certified test results shall be mailed directly to the Owner for all tests requested.

The Owner will record time required by Owner and Owner's consultants in evaluating substitutions proposed by Contractor and in making changes in the Drawings or Specifications occasioned thereby. Whether or not Owner accepts a proposed substitute, Contractor shall reimburse Owner for the changes of Owner and Owner's consultants for evaluating any proposed substitute.

109-2.35 REGULATOR CONTROLS. Provide a new FAA L-854 radio controller, antenna, and all interconnecting power and control wiring, to replace the existing L-854 radio controller at the air traffic control tower. Existing RTU interface panel and L-821 panel shall be reused, without changes.

The new L-854 radio shall be a receiver that is a single-conversion superheterodyne design, operating at a nominal radio frequency within the VHF band 118 to 136 MHz. The sensitivity shall be adjustable from 1 to 30 microvolts as desired by the Owner, permitting a control range of 1 to 20 miles. The receiver shall be programmed to operate on any frequency within the specified VHF range. Decoding shall be solid-state digital circuitry, which shall be designed to sense the presence of three, five or seven pulses within a five-second time period. The digital circuitry upon determining that any of these conditions exist shall affect proper output relay closures. The radio shall be provided with a suitable remote antenna, mast and mounting hardware for the antenna, and suitable cable and connections for antenna connection to the radio.

109-2.36 ELECTRIC UNIT HEATER AND AIR CONDITIONER. Provide new electric unit heater and/or combined through wall air conditioner and heater and all associated conduit and wire. Air conditioner shall be rated not less than 12,000 BTU. Heater shall be rated not less than 5 KW.

109-2.37 BACKBOARD. Provide backboard for mounting all equipment for all electrical cabling. Backboards shall be a minimum of ¾-inch exterior grade plywood, firmly anchored to walls and with a paint finish in accordance with industry standards or as specified by the Airport or as directed by the Engineer.

Backboards are required on all interior walls of the new vault building.

109-2.38 STAND-BY POWER. This facility has no provisions for the installation of stand-by power.

109.2.39 REMOVALS. Remove all regulators, panels, disconnects, etc. from the existing electrical vault at the airfield.

109-2.40 MAIN SERVICE CIRCUIT BREAKER. Provide NEMA 4XSS, 400 ampere, 3 pole, 240 volt, circuit breaker for utility service. Ground per National Electrical Code. Breaker shall have an interrupting rating in rms symmetrical amperes at 240 volts that exceeds the available fault current. Provide utility documentation of available fault current with shop drawings or submission will be rejected.

109-2.41 TAXIWAY REGULATOR. The taxiway regulator shall be the existing regulator relocated to the new vault. The existing regulator is 20 KW, 208 volt, with 120 volt control power, 3 step, 6.6 Ampere, dry type. Provide power from panel board. Provide new S-1 series cutout, and wire from regulator to the S-1 cutout. Connect controls as required.

109-2.42 APRON LIGHTING CONTROLS. Provide time clock, manual pushbutton station, lighting contactors and photoelectric controls for new apron lighting. Provide all conduit and wiring to interconnect controls and provide lighting power from panel board to the lighting contactors. All wiring from the lighting contactors to the lighting equipment, and all the lighting poles, pole bases, lamps, etc. are part of other pay items.

109-2.43 DEMOLITION AND DISPOSAL OF OLD REGULATOR, SERVICE AND ENCLOSURE. The existing runway 2-20 lighting regulator, electric service, and related components in the existing electrical enclosure will no longer be needed once the new electrical vault is in service. All unused components, the 2-20 regulator, the enclosure, the enclosure pad and all ancillary unused components shall be removed and legally disposed of by the Contractor. The regulator tag indicates that the regulator contains 85 gallons of cooling oil.

CONSTRUCTION METHODS

CONSTRUCTION OF VAULT

109-3.1 GENERAL. It is essential that the work required to provide a new transformer vault be properly planned and effectively managed in order to not interrupt operations at the Airport. All conduits and new cable shall be installed while the existing systems remain operational.

The Contractor shall furnish and install and connect all specified equipment, equipment accessories, cables, wires, grounds and support necessary to insure complete and operable electrical systems as specified herein and shown on the contract drawings.

All work shall be performed in accordance with the contract drawings, these specifications and all referenced FAA Advisory Circulars and Orders, the National Electric Code (NEC), and state and local building codes.

All electrical materials shall be new and as approved by the Underwriters' Laboratories, Inc., except as otherwise specified herein. Defective equipment or equipment damaged in the course of the installation or during testing shall be replaced or repaired in a manner meeting the approval of the Engineer. The plans indicate the extent and general arrangement of the equipment, conduit and wiring systems. If any departures from the plans are deemed necessary by the Contractor, details of such departures and the reasons shall be submitted in writing to the Engineer for approval as soon as practicable and within 15 days after award of the contract. No such departures shall be made without the prior written approval of the Engineer.

The Contractor shall coordinate all work associated with the installation of power to the vault with FAA Facilities, the Airport, the local Utility and the Engineer.

The Contractor shall clear, grade, and seed the area around the vault or metal housing for a minimum distance of 10 feet (3 m) on all sides. The slope shall be not less than 1/2-inch per foot (40 mm per m) away from the vault or metal housing in all directions.

109-3.2 TRANSFORMER VAULT BUILDING. The Contractor shall install a new vault building at the location and in accordance with the details shown on the Contract Drawings. The Contractor shall verify the proper installation and location of all conduits before casting the new concrete foundation and floor for the vault building. Once the new foundation and floor are completed, the Contractor shall install the new precast concrete building on the new foundation. Before installing the new building, the Contractor shall insure that all equipment and components are secure within the building so they will not be damaged during installation and that all duct runs and penetrations are installed properly and in the correct location.

The Contractor shall construct a new foundation and concrete floor for the new vault building as

indicated on the plans.

The Contractor shall furnish and install all conduits, wiring, underground cable, underground ducts, junction boxes, ground rods, grounding cable, electrical components, and miscellaneous hardware and fittings necessary for the installation of the new vault building in accordance with these specifications, the Contract Drawings, the cited FAA Advisory Circulars and Orders and all applicable building codes.

The Contractor shall construct the transformer vault at the location indicated on the plans. Vault construction shall be reinforced concrete, or concrete masonry, as specified. The mounting pad or floor details, installation methods, and equipment placement are shown on the plans.

109-3.3 FOUNDATION AND WALLS.

a. Reinforced Concrete Construction. The Contractor shall construct the foundation and walls in accordance with the details shown in the plans. Unless otherwise specified, internal ties shall be of the mechanical type so that when the forms are removed the ends of the ties shall be at least 1-inch (25 mm) beneath the concrete surface; the holes shall be plugged and finished to prevent discoloration. Reinforcing steel shall be placed, as shown in the drawings, and secured in position to prevent displacement during the concrete placement.

The external surfaces of the concrete shall be thoroughly worked during the placing operation to force all coarse aggregate from the surface. Thoroughly work the mortar against the forms to produce a smooth finish free from air pockets and honeycomb.

The surface film of all pointed surfaces shall be removed before setting occurs. As soon as the pointing has set sufficiently, the entire surface inside and outside of the vault shall be thoroughly wet with water and rubbed with a No. 16 carborundum stone, or equal quality abrasive, bringing the surface to a paste. All form marks and projections shall be removed. The surface produced shall be smooth and dense without pits or irregularities. The materials which have been ground into a paste during the rubbing process shall be spread or brushed uniformly over the entire surface (except the interior surfaces that are to be painted shall have all paste removed by washing before painting) and permitted to reset. Final exterior finish shall be obtained by rubbing with No. 30 carborundum stone, or an equal quality abrasive. The surface shall be rubbed until the entire surface is smooth and uniform in color.

b. Brick and Concrete Construction. When this type of construction is specified, the foundation shall be concrete conforming to the details shown in the plans. The outer edge of the foundation at the floor level shall be beveled 1-1/2 inches (37 mm) at 45 degrees. Brick walls shall be 8 inches (200 mm) thick, laid in running bond with every sixth course a header course. Brick shall be laid in cement mortar (1 part masonry cement and 3 parts sand) with full mortar bed and shoved joints. All joints shall be completely filled with mortar, and facing brick shall be back-parged with mortar as work progresses. All joints shall be 3/8 inch (9 mm) thick, exterior joints tooled concave, and interior joints struck flush. Both interior and exterior brick surfaces shall be cleaned and nail holes, cracks and other defects filled with mortar. When specified, a nonfading mineral pigment mortar coloring shall be added to the mortar. Steel reinforcing bars, 3/8-inch (9 mm) in diameter and 12 inches (300 mm) long, shall be set vertically in the center of the brick wall on not more than 2-foot (60 cm) centers to project 2-1/2 (60 mm) inches into the concrete roof slab. Lintels for supporting the brickwork over doors, windows, and louvers shall consist of two 4- x 3- x 3/8-inch (100 x 75 x 9 mm) steel angles.

Lintels shall be painted with one coat of red lead before installation, and all exposed parts shall be painted similar to doors and window sash after installation.

Window sills may be concrete poured in place or precast concrete as indicated in the plans. All exposed surfaces shall have a rubbed finish as specified under reinforced concrete construction. After completion, all interior and exterior faces of walls shall be scrubbed with a solution of muriatic acid and water in the proportions of not less than 1 part acid to 10 parts of water. All traces of efflorescence, loose mortar, and mortar stain shall be removed, and the walls washed down with clear water.

c. **Concrete Masonry Construction.** When this type of construction is specified, the foundation shall be concrete conforming to the details shown in the plans. The concrete masonry units shall be standard sizes and shapes and shall conform to ASTM C 90 and shall include the closures, jambs, and other shapes required by the construction as shown in the plans. Standard construction practice shall be followed for this type of work including mortar, joints, reinforcing steel for extensions into roof slab, etc. Plaster for interior walls, if specified, shall be portland cement plaster.

109-3.4 ROOF. The roof shall be reinforced concrete as shown in the plans. Reinforcing steel shall be placed as shown in the drawing and secured in position to prevent displacement during the pouring of the concrete. The concrete shall be poured monolithically and shall be free of honeycombs and voids. The surface shall have a steel-trowled finish and shall be sloped as shown in the drawing. The underside of the roof slab shall be finished in the same manner as specified for walls.

One brush or mop coat of hot asphalt roof coating shall be applied to the top surface of the roof slab. The asphalt material shall be heated to within the range specified by the manufacturer and immediately applied to the roof. The finished coat shall be continuous over the roof surface and free from holidays and blisters. Smears and dribbles of asphalt on the roof edges and building walls shall be removed.

109-3.5 FLOOR. The floor shall be reinforced concrete as shown in the drawings. When present, all sod, roots, refuse, and other perishable material shall be removed from the area under the floor to a depth of 8 inches (200 mm), unless a greater depth is specified in the invitation for bids. This area shall be backfilled with materials consisting of sand, cinders, gravel, or stone. Fill shall be placed in layers not to exceed 4 inches (100 mm) and shall be thoroughly compacted by tamping or rolling. A layer of building paper shall be placed over the fill prior to placing concrete. The floor surfaces shall have a steel-trowled finish. The floor shall be level unless a drain is specified, in which case the floor shall be pitched 1/4-inch (6 mm) per foot downward toward the drain. A 1/4-inch (6 mm) asphalt felt expansion joint shall be placed between floor and foundation walls. The floor shall be poured monolithically and shall be free of honeycombs and voids.

109-3.6 FLOOR DRAIN. If shown in the plans, a floor drain and dry well shall be installed in the center of the floor of the equipment room. The dry well shall be excavated 4 x 4 feet (120 x 120 cm) square and to a depth of 4 feet (120 cm) below the finished floor elevation and shall be backfilled to the elevation of the underside of the floor with gravel - which shall all pass a 2-inch (50 mm) mesh sieve and shall all be retained on a 1/4-inch (6 mm) mesh sieve. The gravel backfill shall be placed in 6-inch (150 mm) maximum layers, and the entire surface of each layer shall be tamped either with a mechanical tamper or with a hand tamper weighing not less than 25 pounds (11 kg) and having a face area of not more than 36 square inches (234 square cm)

nor less than 16 square inches (104 square cm). The drain inlet shall be set flush in the concrete floor. The drain shall have a clear opening of not less than 8 inches (200 mm) in diameter.

109-3.7 CONDUITS IN FLOOR AND FOUNDATION. Conduits shall be installed in the floor and through the foundation walls in accordance with the details shown in the plans. All underground conduit shall be painted with a bituminous compound. Conduit shall be installed with a coupling or metal conduit adapter flush with the top of the floor. All incoming conduit shall be closed with a pipe plug to prevent the entrance of foreign material during construction. Space conduit entrances shall be left closed.

109-3.8 DOORS. Doors shall be metal-clad fireproof class A doors conforming to requirements of the National Electric Code and local electrical codes.

109-3.9 PAINTING. The floor, ceiling, and inside walls of concrete construction shall first be given a hardening treatment, after which the Contractor shall apply two coats of paint as specified below, except that interior face brick walls need not be painted. The hardening treatment shall consist of applying two coats of either a commercial floor hardener or a solution made by dissolving 2 pounds (0.9 kg) of magnesium fluosilicate or zinc sulphate crystals in 1 gallon (liter) of water. Each coat shall be allowed to dry at least 48 hours before the next application. After the second treating coat has dried, the surfaces shall be brushed clean of all crystals and thoroughly washed with clear water. Paint for walls and ceiling shall be a light gray color approved by the Engineer. The floor paint shall be a medium gray color approved by the Engineer. Before painting, the surfaces shall be dry and clean. The first coat shall be thinned by adding 2/3-quart (0.166 liters) of spar varnish and 1/3-quart (0.083 liters) of turpentine to each gallon (liter) of paint. The second coat shall be applied without thinning. All doors, lintels, and windows shall be cleaned to remove any rust or foreign material and shall be given one body and one finish coat of white paint. Bare metal surfaces shall be given a prime coat of red lead prior to the body and finish coats.

109-3.10 LIGHTS AND SWITCHES. The Contractor shall furnish and install indicated duplex convenience outlets in the vault room.

INSTALLATION OF EQUIPMENT IN VAULT

109-4.1 GENERAL. The Contractor shall furnish, install, and connect all equipment, equipment accessories, conduit, cables, wires, grounds and support necessary to insure a complete and operable electrical distribution center for the runway and taxiway lighting systems as specified herein and shown in the plans.

The equipment installation and mounting shall comply with the requirements of the National Electrical Code and local code agency having jurisdiction.

109-4.2 POWER SUPPLY EQUIPMENT. Regulators and other power supply equipment items shall be furnished and installed at the location shown in the plans or as directed by the Engineer. The power supply equipment shall be set on steel "H" sections, "I" beams or channels to provide a minimum space of 1½ inches between the equipment and the floor. The equipment shall be placed so as not to obstruct the name-plates.

109-4.3 PANELBOARDS. Examine areas and conditions under which panelboards and

enclosures are to be installed, and notify Contractor in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

Install panelboards and enclosures as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC standards and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486A and B.

Fasten enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically anchored.

Provide properly wired electrical connections for panelboards within enclosures.

Fill out panelboard's circuit directory card upon completion of installation work.

Provide equipment grounding connections for panelboard enclosures as indicated. Tighten connections to comply with tightening torques specified in UL 486A to assure permanent and effective grounds.

Prior to energization of electrical circuitry, check all accessible connections to manufacturer's tightening torque specifications.

Prior to energization of panelboards, check with ground resistance tester phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled.

Prior to energization, check panelboards for electrical continuity of circuits, and for short-circuits.

Adjust operating mechanisms for free mechanical movement.

Touch-up scratched or marred surfaces to match original finishes.

Subsequent to wire and cable hook-ups, energize panelboards and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

109-4.4 RACEWAYS. Examine areas and conditions under which raceways are to be installed, and substrate which will support raceways. Notify General Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

Install raceways as indicated; in accordance with manufacturer's written installation instructions, and in compliance with NEC, and NECA's "Standards of Installation". Install units plumb and level, and maintain manufacturer's recommended clearances.

Coordinate with other work including wires/cables, boxes, and panel work, as necessary to interface installation of electrical raceways and components with other work.

Mechanically fasten together metal conduits, enclosures, and raceways for conductors to form continuous electrical conductor. Connect to electrical boxes, fittings and cabinets to provide electrical continuity and firm mechanical assembly.

Avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat surfaces with corrosion inhibiting compound before assembling.

Install miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split couplings, and plugs that have been specifically designed and manufactured for their particular application. Install expansion fittings in raceways as required or wherever structural expansion joints are crossed.

Use roughing-in dimensions of electrically operated units furnished by supplier. Set conduit and boxes for connection to units only after receiving review of dimensions and after checking location with other trades.

Provide nylon pull cord in all empty conduits. Test conduits required to be installed, but left empty, with ball mandrel. Clear any conduit which rejects ball mandrel. Pay costs involved for restoration of conduit and surrounding surfaces to original condition.

Provide rigid steel zinc-coated conduit where conduit is installed exposed, indoors or outdoors.

Use liquid-tight flexible conduit where indicated on the plans.

Cut conduits straight, properly ream, and cut threads for heavy wall conduit deep and clean.

Field-bend conduit with benders designed for purpose so as not to distort nor vary internal diameter.

Size conduits to meet NEC, except no conduit smaller than $\frac{3}{4}$ inch shall be embedded in concrete or masonry.

Fasten conduit terminations in sheet metal enclosures by 2 locknuts, and terminate with bushing. Install locknuts inside and outside enclosure.

Conduits are not to cross pipe shafts, or ventilating duct openings.

Keep conduits a minimum distance of 6" from parallel runs of flues, hot water pipes or other sources of heat. Wherever possible, install horizontal raceway runs above water and steam piping.

Use of running threads at conduit joints and terminations is prohibited. Where required, use 3-piece union or split coupling.

Complete installation of electrical raceways before starting installation of cables/wires within raceways.

Install underground conduits minimum of 24" below finished grade, unless otherwise indicated on the plans.

Install conduits as not to damage or run through structural members. Avoid horizontal or cross runs in building partitions or side walls.

Install exposed conduits and extensions from concealed conduit systems neatly, parallel with, or at right angles to walls of building.

Install exposed conduit work as not to interfere with ceiling inserts, lights or ventilation ducts or outlets.

Support exposed conduits by use of hangers, clamps, or clips.

The above requirements for exposed conduits also apply to conduits installed in space above hung ceilings.

109-4.5 CONDUIT FITTINGS. Construct locknuts for securing conduit to metal enclosure with sharp edge for digging into metal, and ridged outside circumference for proper fastening.

Bushings for terminating conduits smaller than 1-1/4" are to have flared bottom and ribbed sides, with smooth upper edges to prevent injury to cable insulation.

Install insulated type bushings for terminating conduits 1-1/4" and larger. Bushings are to have flared bottom and ribbed sides. Upper edge to have phenolic insulating ring molded into bushing.

Bushing of standard or insulated type to have screw type grounding terminal.

Miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split couplings, and plugs to be specifically designed for their particular application.

Mechanically assemble metal enclosures, and raceways for conductors to form continuous electrical conductor, and connect to electrical boxes, fittings and cabinets as to provide effective electrical continuity and rigid mechanical assembly.

Avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat all surfaces with corrosion inhibiting compound before assembling.

Install expansion fittings in all raceways wherever structural expansion joints are crossed.

Make changes in direction of raceway run with proper fittings, supplied by raceway manufacturer. No field bends of raceway sections will be permitted.

Properly support and anchor raceways for their entire length by structural materials. Raceways are not to span any space unsupported.

Use boxes as supplied by raceway manufacturer wherever junction, pull or devices boxes are required. Standard electrical "handy" boxes, etc. shall not be permitted for use with surface raceway installations.

109-4.6 NEW ELECTRICAL SERVICE. Provide a new secondary electrical service from utility pole mounted transformers, including conduits/ducts with conductors from the transformer,

underground, to the new power meter and main breaker near the power pole, and from the main disconnect to the panel board in the vault. Provide all wire, conduit, and appurtenant items to connect the power to the new main electrical service panel in the vault.

109-4.7 WIRING AND CONNECTIONS. The Contractor shall make all necessary electrical connections in the vault in accordance with the wiring diagrams furnished, all manufacturers requirements, and as directed by the Engineer to ensure a complete and operating system, whether shown on these documents or part of manufacturers schematics. In wiring to the terminal blocks, the Contractor shall leave sufficient extra length on each control lead to make future changes in connections at the terminal block. This shall be accomplished by running each control lead the longest way around the box to the proper terminal. Leads shall be neatly laced in place.

109-4.8 MARK AND LABELING. All equipment, control wires, terminal blocks, etc., shall be tagged, marked, or labeled as specified below:

a. Wire Identification. The Contractor shall furnish and install self-sticking wire labels or identifying tags on all control wires at the point where they connect to the control equipment or to the terminal blocks. Wire labels, if used, shall be of the self-sticking preprinted type and of the manufacturer's recommended size for the wire involved. Identification markings designated in the plans shall be followed. Tags, if used, shall be of fiber not less than 3/4 inch in diameter and not less than 1/32 inch thick. Identification markings designated in the plans shall be stamped on tags by means of small tool dies. Each tag shall be securely tied to the proper wire by a nonmetallic cord.

b. Labels. The Contractor shall stencil identifying labels on the cases of regulators, breakers and distribution and control relay cases with white oil paint as designated by the Engineer. The letters and numerals shall be not less than 1 inch in height and shall be of proportionate width. The Contractor shall also mark the correct circuit designations in accordance with the wiring diagram on the terminal marking strips which are part of each terminal block.

109-4.9 GROUNDING AND BONDING. Examine areas and conditions under which electrical grounding and bonding connections are to be made and notify Contractor in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

109-4.10 INSTALLATION OF ELECTRICAL GROUNDING AND BONDING SYSTEMS. Install electrical grounding and bonding systems as indicated, in accordance with manufacturer's instructions and applicable portions of NEC, NECA's "Standard of Installation", and in accordance with recognized industry practices to ensure that products comply with requirements.

Coordinate with other electrical work as necessary to interface installation of electrical grounding and bonding system work with other work.

Weld grounding conductors to underground grounding electrodes.

Connect together system neutral, service equipment enclosures, exposed noncurrent carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables and receptacle ground connectors.

Terminate feeder and branch circuit insulated equipment grounding conductors with grounding

lug, bus, or bushing.

Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with tightening torque values specified in UL 486A to assure permanent and effective grounding.

Route grounding connections and conductors to ground and protective devices in shortest and straightest paths as possible to minimize transient voltage rises.

Apply corrosion-resistant finish to field-connections, buried metallic grounding and bonding products, and places where factory applied protective coatings have been destroyed, which are subjected to corrosive action.

Install clamp-on connectors on clean metal contact surfaces, to ensure electrical conductivity and circuit integrity.

Upon completion of installation of electrical grounding and bonding systems, test ground resistance with ground resistance tester. Where tests show resistance-to-ground is over 25 ohms, take appropriate action to reduce resistance to 25 ohms, or less, by driving additional ground rods; then retest to demonstrate compliance.

109-4.11 WIREWAYS. Installation shall be in accordance with NEMA and manufacturers recommendations as described in the instruction accompanying the product.

Install wireways parallel with ceiling and structural members.

109-4.12 PULLBOXES. Provide boxes and fittings in the wiring or raceway systems wherever required for pulling of wires, making connections and mounting of devices for metallic raceways shall be of the cast-metal hub type when located in normally wet locations, when surface mounted on outside of exterior surfaces, when installed exposed up to 7 feet above interior floors and walkways and when installed in hazardous areas. Boxes in other locations shall be sheet steel. Each box shall have the volume required by NFPA 70 for the number of conductors enclosed in the box. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or block, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel work. Threaded studs driven in by used, where use of this equipment complies with local safety regulations, in lieu of wood screws, expansion shields, or machine screws.

109-4.13 MEDIUM VOLTAGE SPLICING. Install splices at pull points and elsewhere using standard kit. Conform to kit manufacturer's written instructions.

109-4.14 CUTOVER TO NEW ELECTRICAL VAULT. Construction shall be phased so that the new electrical vault is placed in service prior to disconnecting the existing electrical vault. One day (7 am to 7 pm) will be allotted to disable the runway lighting system to make terminations in the new vault. 24 hours will be allowed to disable the taxiway lighting system to move the regulator and make terminations in the new electrical vault. All other outages must be scheduled with the Airport and occur when lighting is not needed.

METHOD OF MEASUREMENT

109-5.1 NEW AIRFIELD LIGHTING VAULT. The new airfield lighting vault will not be measured separately for payment but shall be measured as a single item including furnishing and installing new pre-cast building, furnishing and installing new regulator, new electrical service, new radio control and connections to the existing interface with regulator, new S-1 cutouts, series circuit monitor, apron lighting controls, panel boards, wireways, all conduit, wiring, contactors, junction boxes, switches, relays, circuit breakers, electrical connections, electrical components, miscellaneous hardware and fittings; all completed, tested, accepted, and ready for operation.

BASIS OF PAYMENT

109-6.1 PAYMENT. Payment will be made at the contract lump sum price for the new airfield lighting vault. This price shall be full compensation for furnishing all materials and for all preparation, assembly and installation of these materials, and for all labor, equipment, tools and incidentals.

Payment will be made under:

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>UNIT</u>
L-109-1	New Airfield Lighting Vault	Lump Sum

MATERIAL REQUIREMENTS

Fed.Spec. J-C-30	Cable and Wire, Electrical (Power, Fixed Installation)
Fed. Spec. W-C-571	Conduit and Fittings, Nonmetal, Rigid; (Asbestos Cement or Fire-Clay Cement), (For Electrical Purposes)
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/535-10E	Specification for Constant Current Regulators and Regulator Monitors
ASTM A 615	Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement
ASTM C 62	Specifications for Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM D 83	Red Lead Pigment

REA BULLETIN 345-14 REA Specification for Fully Color-Coded,
Polyethylene-Insulated, Double
Polyethylene-Jacketed Telephone Cables for Direct Burial

END OF ITEM L-109