SECTION 70 – AIRPORT TRANSFORMER VAULT AND VAULT EQUIPMENT
(FAA L-109)

70-1 GENERAL

The Contractor shall perform all work required by the plans and specifications for construction of transformer vault for airfield electrical service in accordance with the Standard Specifications, except as specified otherwise in FAA Specification Item L-109, as included and modified hereafter, and as shown on the Plans.

ITEM L-109 AIRPORT TRANSFORMER VAULT AND VAULT EQUIPMENT

DESCRIPTION

109-1.1 This item shall consist of constructing an airport transformer vault or a prefabricated metal housing these specifications in accordance with the design and dimensions shown in the plans. This work shall also include the installation of conduits in floor and foundation, painting and lighting of the vault or metal housing, and the furnishing of all incidentals necessary to produce a completed unit. Included as a separate part under this item or as a separate item where an existing vault is to be utilized shall be the furnishing of all vault equipment, wiring, electrical buses, cable, conduit, potheads, and grounding systems. This work shall also include the painting of equipment and conduit; the marking and labeling of equipment and the labeling or tagging of wires; 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.

Because of the specialized nature of the work, the Electrical Contractor and Job Superintendent shall have verifiable five years minimum of airfield electrical construction experience

EQUIPMENT AND MATERIALS

109-2.1 GENERAL.

a. Airport lighting equipment and materials covered by Federal Aviation Administration (FAA) specifications shall be ~~certified and listed~~ approved under the Airport Lighting Equipment Certification Program described in Advisory Circular (AC) 150/5345-53, Airport ~~Lighting Equipment Certification Program~~ current version, as well as approved by a City of Los Angeles Recognized Electrical Field Testing Agency.

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. Manufacturer's certifications shall not relieve the Contractor of the Contractor's responsibility to provide materials in accordance with these specifications and acceptable to the Engineer. Materials supplied and/or installed that do not materially comply with these specifications shall be removed, when directed by the Engineer and replaced with materials, which do comply with these specifications, at the sole cost of the Contractor.

d. All materials and equipment used to construct this item shall be submitted to the Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog

sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify pertinent products or models applicable to this project. Indicate all optional equipment and delete non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment for which they apply on each submittal sheet. Markings shall be boldly and clearly made with arrows or circles (highlighting is not acceptable). Contractor is solely responsible for delays in project accruing directly or indirectly from late submissions or resubmissions of submittals.

e. The data submitted shall be sufficient, in the opinion of the Engineer, to determine compliance with the plans and specifications. ~~[The Contractor's submittals shall be neatly bound in a properly sized 3-ring binder, tabbed by specification section.]~~ The Engineer reserves the right to reject any and all equipment, materials or procedures, which, in the Engineer's opinion, does not meet the system design and the standards and codes, specified herein.

f. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner

109-2.2 CONCRETE. The concrete for the vault shall be proportioned, placed, and cured in accordance with Item P-610, Structural Portland Cement Concrete, using ¾-inch (18 mm) maximum size coarse aggregate.

109-2.3 REINFORCING STEEL. Reinforcing steel bars shall be intermediate or structural grade deformed-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 RIGID STEEL CONDUIT. Rigid steel conduit and fittings shall be in accordance with Underwriters Laboratories Standard 6 and 514.

109-2.6 LIGHTING. Vault or metal-housing light fixtures shall be of a vaporproof type, with RFI suppressors and RF type lenses for reduction of lamp radiation.

109-2.7 OUTLETS. Convenience outlets shall be 20A, heavy-duty duplex units designed for industrial service with stainless steel cover plates and meet all the requirements of the California Electrical Code, and Los Angeles Electrical Code, current versions.

109-2.8 SWITCHES. ~~Vault or metal-housing light switches shall be single-pole switches.~~ Light or fixture switches shall be heavy-duty single-pole units designed for industrial service with stainless steel cover plates and meet all the requirements of the California Electrical Code, and Los Angeles Electrical Code, current versions.

109-2.9 PAINT.

a. Priming paint for ungalvanized metal surfaces shall be a high solids alkyd primer conforming to TT-P-664D.

b. White paint for body and finish coats on metal and wood surfaces shall be ready-mixed paint conforming to the Master Painter's Institute, Reference #9, Exterior Alkyd, Gloss, VOC Range E2.

c. Priming paint for wood surfaces shall be mixed on the job by thinning the above specified white paint by adding 1/2 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 blue and the floor shall be medium gray.

e. The roof coating shall be ~~hot asphalt material in accordance with ASTM D 2823~~ a thermo plastic membrane type roofing.

109-2.10 HIGH VOLTAGE BUS. High-voltage bus shall be standard weight 3/8-inch (9 mm) IPS copper tubing of the size and voltage rating specified.

109-2.11 BUS CONNECTORS. Connectors shall be similar to Burndy Type NT (or equivalent) for copper tubing. Connectors for insulated bus cable shall be of the proper size and type for the service intended.

109-2.12 BUS SUPPORTS. Bus supports shall be similar to Westinghouse No. 527892 (or equivalent), insulated for 7,500 volts, single clamp type for 2-bolt flat mounting.

109-2.13 GROUND BUS. Ground bus shall be 1/8 - x ¾-inch (3 x 18 mm) minimum copper bus bar.

109-2.14 SQUARE DUCT. Duct shall be square similar to that manufactured by the Square D Company (or equivalent), or the Trumbull Electric Manufacturing Company (or equivalent). The entire front of the duct on each section shall consist of hinged or removable cover for ready access to the interior. The cross section of the duct shall be not less than 4 x 4 inches (100 x 100 mm) except where otherwise shown in the plans.

109-2.15 GROUND RODS. Ground rods shall be copper or copper-clad of the length and diameter specified in the plans.

109-2.16 POTHEADS. Potheads shall be similar to G&W Type N, Shape C (or equivalent), unless otherwise specified. Potheads shall be furnished with plain insulator bushings and conduit couplings. Potheads shall have a rating not less than the circuit voltage.

109-2.17 PREFABRICATED METAL HOUSING. The prefabricated metal housing shall be a commercially available unit.

109-2.18 EMERGENCY GENERATORS. Emergency generators shall be diesel powered, sized according to plan and capable of supporting all airfield lighting and emergency vault equipment. Generators shall meet all requirements indentified for Emergency Generators in NFPA 110.

109-2.19 CONSTANT CURRENT REGULATORS

a. Constant Current Regulators (CCR) shall conform to the requirements of FAA Advisory Circular Number 150/5345-10, Latest Edition "Specification for Constant Current Regulators and Regulator Monitors."

b. Constant Current Regulators shall be: Type L-828, Regulator, Class 1, 6.6 amperes; Style 1, three brightness steps. Constant Current Regulators shall be suitable for connection to a 208 volt, 1 phase, and 60 Hertz supply. Constant Current Regulators shall be air-cooled ferroresonant dry type of the

Kilowatt rating indicated on the Plans. SCR type regulators are not acceptable. CCR shall be as manufactured by Hevi-Duty to match existing CCR or approved equal.

c. Provide integral multi step local control switch, ammeter, lightning and surge protection on input and output lines, open circuit protection and indication, over current protection and indication.

d. Constant Current Regulator minimum input power factor shall be 95 percent when measured on the highest intensity setting.

e. Constant Current Regulator minimum efficiency shall be 90 percent when measured on the highest intensity setting.

f. The regulators shall be suitable for remote control from a 120 volt control source and shall be capable of remote reset.

g. Provide with interface for the ALCMS from remote locations. Existing monitoring system is manufactured by Crouse-Hinds Airport Lighting Products. CCR shall be provided with dry contacts for 'local' and 'remote' positions.

h. Install floor mounted regulators within the Airfield Lighting Vault at the locations indicated. Interconnect equipment and devices to provide a complete installation.

i. Install and adjust in accordance with manufacturers' requirements. Install all conductors in conduit.

j. Demonstrate the operation of all features of the system.

109-2.20 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 150/5345-3 Specification for L-821 Panels for Remote Control of Airport Lighting

AC 150/5345-5 Circuit Selector Switch

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 Regulator Monitors

AC 150/5345-13 Specification for L-841 Auxiliary Relay Cabinet Assembly for Pilot Control of Airport Lighting Circuits.

109-2.21 OTHER ELECTRICAL EQUIPMENT. Constant-current regulators, distribution transformers, ~~oil switches,~~ cutouts, relays, terminal blocks, transfer relays, circuit breakers, emergency generators and all other regularly used commercial items of electrical equipment not directly covered and or required 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~~ an approved City of Los Angeles Recognized Electrical Field Testing Agency, indicating that the

equipment meets the specifications and local city requirements, shall be supplied. In all cases, equipment shall be new and a 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.

109-2.22 WIRE. Wire in conduit rated up to 5,000 volts shall conform to AC 150/5345-7, Specification for L-824 Underground Electrical Cables for Airport Lighting Circuits, as indicated in Specification section S69, for rubber insulated neoprene-covered wire, or Fed. Spec. J-C-30, Type RHW, for rubber insulated fibrous-covered wire. For ratings up to 600 volts, thermoplastic wire conforming to Fed. Spec. J-C-30, Type THWN, shall be used. The wires shall be of the type, size, number of conductors, and voltage shown in the plans or in the proposal.

a. Control Circuits. Unless otherwise indicated on the plans, wire shall be not less than No. 12 AWG and shall be insulated for 600 volts. ~~If~~ Where telephone control cable is specified, No. 19 AWG telephone cable conforming to ICEA S-85-625-1996 specifications shall be used. Fiber Optic lines, splices, patch panels and terminations shall meet with the requirements of Specification Section 77.

b. Power Circuits.

(1) 600 volts maximum-Wire shall be No. ~~6~~ 12 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.~~ Over 600 volts-Wire shall be No. 8 AWG or larger and insulated for at least the circuit voltage.

~~**(3)** Over 3,000 volts-Wire shall be No. 6 AWG or larger and insulated for at least the circuit voltage.~~

CONSTRUCTION METHODS

109-3.1 GENERAL. The Contractor shall construct the transformer vault or prefabricated metal housing at the location indicated in the plans. Vault construction shall be reinforced concrete and concrete masonry block ~~or brick wall~~ as specified. The metal housing shall be prefabricated equipment enclosure to be supplied in the size specified. The mounting pad or floor details, installation methods, and equipment placement are shown in the plans.

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 ½-inch per foot (40 mm per m) away from the vault or metal housing in all directions.

The vault shall provide adequate protection against weather elements, including rain, wind-driven dust, ~~snow, ice~~ and excessive heat. The vault shall have sufficient filtered ventilation, to assure that the interior room temperatures and conditions do not exceed the recommended limits of the electrical equipment to be installed in the vault. Contractor is responsible for contacting the manufacturer of the equipment to be installed to obtain environmental limitations of the equipment to be installed.

109-3.2 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 equivalent 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 equivalent 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 1-½ inches (37 mm) at 45 degrees. Brick walls shall be 8 inches (200 cm) 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 2-½(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 corrosion inhibiting primer 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.~~

109-3.3 ROOF. The roof shall be corrugated metal with ~~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-troweled 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.~~

The Feltback PVC Thermoplastic roofing membrane with flashings and other components to comprise a roofing system, shall be applied only by a Roofing Contractor authorized by the manufacturer prior to bid ("Applicator"). The Roofing Contractor shall have at least five (5) years of experience as an applicator with the submitted manufacturer as certified by the manufacturer.

109-3.4 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-troweled finish. The floor shall be level unless a drain is specified, in which case the floor shall be pitched ¼-inch (6 mm) per foot downward toward the drain. A ¼-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.

109-3.5 FLOOR DRAIN. ~~If shown in the plans,~~ A floor drain and sump pump 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 ¼ 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.

109-3.6 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.

109-3.7 DOORS. Doors shall be metal-clad fireproof class a doors conforming to requirements of the National Electric Code and local electrical codes.

109-3.8 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. 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 blue color approved by owner. 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 corrosion-inhibiting primer prior to the body and finish coats.

109-3.9 LIGHTS AND SWITCHES. The Contractor shall furnish and install a minimum of ~~two~~ four duplex convenience outlets in the vault room, or as specified on the plans, whichever is greater. Where a control room is specified, at least ~~two~~ six duplex outlets shall be installed.

109-3.10 EMERGENCY GENERATOR. The Contractor shall furnish and install Emergency Generator as specified on the plans. Generators shall be installed on 4" raised equipment pads with vibration isolators, outdoor above ground diesel tank and a veeder root leak detection system.

108-3.8 TESTING. The Contractor shall furnish all necessary equipment and appliances for testing the vault electrical systems and circuits before and after installation. The Contractor shall report all tests to the Engineer. The Contractor shall demonstrate the electrical characteristics to the satisfaction of the Engineer. All costs for testing are incidental to the respective item being tested. For phased projects, the tests must be completed by phase and results meeting the specifications below must be maintained by the Contractor throughout the entire project as well as during the ensuing warranty period.

Earth resistance testing methods shall be submitted to the Engineer for approval. Earth resistance testing results shall be recorded on an approved form and testing shall be performed in the presence of the Engineer. All such testing shall be at the sole expense of the Contractor.

Should any part of the electrical system be damaged or suspected of being damaged by construction activities the Contractor shall test the system for continuity. The Engineer shall approve of the test method selected. All such testing shall be at the sole expense of the Contractor.

Two copies of tabulated results of all cable tests performed shall be supplied by the Contractor to the Engineer. Where connecting new cable to existing cable, ground resistance tests shall be performed on the new cable prior to connection to the existing circuit.

There are no approved "repair" procedures for items that have failed testing other than complete replacement.

INSTALLATION OF EQUIPMENT IN VAULT OR PREFABRICATED METAL HOUSING

109-3.10 GENERAL. The Contractor shall furnish, install, and connect all equipment, equipment accessories, conduit, cables, wires, buses, grounds, and support necessary to insure a complete and operable electrical distribution center for the airport lighting system as specified herein and shown in the plans. When specified, an emergency power supply and transfer switch shall be provided and installed.

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

109-3.11 POWER SUPPLY EQUIPMENT. Transformers, regulators, booster transformers, 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, channels, or concrete blocks to provide a minimum space of 1-½ inches (37 mm) between the equipment and the floor. The equipment shall be placed so as not to obstruct the oil-sampling plugs of the oil-filled units; and name-plates shall, so far as possible, not be obscured.~~

~~If specified in the plans and specifications,~~ Equipment for an ~~alternate power source or~~ emergency power generator shall be furnished and installed. The alternate power supply installation shall include all equipment, accessories, an automatic transfer switch, and all necessary wiring and connections. The emergency power generator set shall be the size and type specified.

109-3.12 SWITCHGEAR AND PANELS. ~~Oil switches,~~ Fused cutouts, relays, transfer switches, panels, panel boards, and other similar items shall be furnished and installed at the location shown in the plans or as directed by the Engineer. Wall or ceiling mounted items shall be attached to the wall or ceiling with galvanized bolts of not less than 3/8-inch (9 mm) diameter engaging metal expansion shields or anchors in masonry or concrete vaults.

109-3.13 DUCT AND CONDUIT. ~~The Contractor shall furnish and install square-type exposed metallic ducts with hinged covers for the control circuits in the vault. These shall be mounted along the walls behind all floor-mounted equipment and immediately below all wall-mounted equipment. The hinged covers shall be placed to open from the front side with the hinges at the front bottom.~~

~~Wall brackets for square ducts shall be installed at all joints 2 feet (60 cm) or more apart with intermediate brackets as specified. Conduit shall be used between square ducts and equipment or between different items of equipment when the equipment is designed for conduit connection. When the equipment is not designed for conduit connection, conductors shall enter the square-type control duct through insulating bushings in the duct or on the conduit risers.~~
Rigid Metal Conduit shall be installed in the walls and concrete wherever possible. When the equipment is not designed for rigid metal conduit connections, liquid tight flexible metallic tubing shall be used through insulating bushings in the equipment.

109-3.14 CABLE ENTRANCE AND HIGH-VOLTAGE BUS SYSTEM. Incoming underground cable from field circuits and supply circuits will be installed outside the walls of the transformer vault as a separate item under Item L-108. The Contractor installing the vault equipment shall bring the cables from the trench or duct through the entrance conduits into the vault and make the necessary electrical connections. For the incoming and outgoing high voltage load circuits, the Contractor shall furnish and install rigid metallic ~~vi~~ conduit ~~risers, surmounted by potheads, from floor level to the level as shown in the plans.~~

The incoming high-voltage power supply service to the vault shall enter below the floor of the vault and shall rise from the floor level in a rigid metallic conduit riser, surmounted by a pothead~~, as described above~~. Using insulated high-voltage cable, the incoming power service shall be connected from the pothead to the ~~oil-fused cutouts or to the~~ specified disconnecting switch or equipment. From the ~~oil-fused cutouts or to the specified~~ disconnecting device, the insulated service conductors shall be connected to the main ~~overhead voltage~~ bus system of the vault. The high-voltage bus system shall utilize the materials specified and shall be mounted and installed in accordance with the requirements of the National Electrical Code or the local code agency having jurisdiction.

109-3.15 WIRING AND CONNECTIONS. The Contractor shall make all necessary electrical connections in the vault in accordance with the wiring diagrams furnished and as directed by the Engineer. 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.

109-3.16 MARKING 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 ¾-inch (13 mm) in diameter and not less than 1/32-inch (1 mm) thick. Identification markings designated in the plans shall be stamped on tags by means of smalltool 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~~ metal, non-corrosive nameplates. The letters and numerals shall be stamped, and not less than ~~1~~ 3/4 inch ~~(25 mm)~~ 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 a part of each terminal block.

METHOD OF MEASUREMENT

109-4.1 See Section 69-2 The quantity of vaults to be paid for under this item shall consist of the number of vaults constructed in place and accepted as a complete unit.

109-4.2 The quantity of prefabricated metal housings to be paid for under this item shall consist of the number of housings constructed in place and accepted as a complete unit.

109-4.3 The quantity of vault or prefabricated metal housing equipment to be paid for under this item shall consist of all equipment installed, connected, and accepted as a complete unit ready for operation.

BASIS OF PAYMENT

109-5.1 See Section 69-3. ~~Payment will be made at the contract unit price for each completed and accepted vault or prefabricated metal housing equipment installation. 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 necessary to complete the item.~~

~~Payment will be made under:~~

~~Item L-109-5.1 Construction of Airport Transformer Vault in Place-per unit~~

~~Item L-109-5.2 Installation of Airport Transformer Vault Equipment in Place-per unit~~

~~Item L-109-5.3 Construction of Prefabricated Metal Housing and Foundation in Place-per unit~~

~~Item L-109-5.4 Installation of Prefabricated Metal Housing Equipment in Place-per unit~~

MATERIAL REQUIREMENTS

AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-26	Specification for L-823 Plug and Receptacle Cable Connectors
FED SPEC J-C-30	Cable and Wire, Electrical Power, Fixed Installation (cancelled; replaced by A-A-59544 Cable and Wire, Electrical (Power, Fixed Installation))
FED SPEC A-A-55809	Insulation Tape, Electrical, Pressure-Sensitive Adhesive, Plastic
ASTM B 3	Soft or Annealed Copper Wire
ASTM D 4388	Rubber tapes, Nonmetallic Semiconducting and Electrically Insulating

REFERENCE DOCUMENTS

NFPA No. 70	National Electrical Code (NEC)

MIL-S-23586C	Sealing Compound, Electrical, Silicone Rubber
	Building Industry Consulting Service International (BICSI)
ANSI/IEEE Std 81	IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

END OF ITEM L-109

70-2 METHOD OF MEASUREMENT

Vault equipment shall be measured by the number of linear feet, square feet and per each for each piece of equipment specified in the vault. To include but be limited to; concrete, concrete masonry units, reinforcing steel, rigid steel conduit, lighting, outlets, switches, paint, high-voltage bus, bus connectors, bus supports, ground bus, square duct, ground rods, potheads, prefabricated metal housing, panels, switchboards, transformers, regulators and wire.

70-3 BASIS OF PAYMENT

Payment will be made at the contract unit price for concrete, concrete masonry units, reinforcing steel, rigid steel conduit, lighting, outlets, switches, paint, high-voltage bus, bus connectors, bus supports, ground bus, square duct, ground rods, potheads, prefabricated metal housing, panels, switchboards, transformers, regulators and wire installed in place by the Contractor and accepted by the Engineer. This price shall be full compensation for furnishing all materials and for all preparation and installation of these materials, and for all labor, equipment, tools, and incidentals, necessary to complete this item.

No separate payment will be made for constructing the item under construction sequencing restrictions, including limited access or nighttime work areas.

Trenching and backfilling will not be measured for payment but will be considered incidental to the associated bid item.

END OF SECTION 70

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