

## DIVISION 16 - ELECTRICAL WORK

### SECTION 16050 - ELECTRICAL GENERAL REQUIREMENTS

#### PART 1 GENERAL

##### 1.1 RELATED DOCUMENTS

The General Provision of the contract, including the General Provisions for Construction Projects (2016), Special Provisions, and General Requirements of the Specifications, apply to the work specified in this section.

The requirements of this Section, unless otherwise stated, shall apply to all Division 16 Specification Sections.

##### 1.2 SUMMARY

This Section includes the general requirements for removal and replacement or new construction of portions airfield electrical systems at the Airport. Specific requirements for each portion of the electrical Work of this Contract are including in the related sections listed in Section 1.1. This item covers both FAA and Airfield Lighting Electrical Systems.

The work to be performed includes furnishing all labor, supplies, materials, equipment, transportation, and services required to augment, move, remove, install, and complete electrical work as specified herein and as shown on the plans.

Airport lighting equipment and materials covered by FAA Specifications shall have the prior approval of the Office of Airports, Federal Aviation Administration's Advisory Circular Number 150/5345-53, (Latest Edition) "Airport Lighting Equipment Certification Program."

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

All work shall be performed in strict accordance with these specifications, plans, and any instructions that may be furnished by the Engineer during execution of the work to aid in interpretation of said plans and specifications. Installation details, material and equipment specifications shall be in conformance with all applicable FAA Advisory Circulars.

The specifications indicate desired materials as to type and quality. Wherever proprietary names are listed in these specifications, it shall be interpreted that the words "or equal" follow. "Or equal" shall be interpreted as meaning equal in every respect as determined by the Engineer.

Nothing in these plans and specifications is to be construed as permitting work not conforming to governing codes and regulations. Where two or more codes conflict, the more stringent or strict requirement shall apply.

The work includes, but is not limited to the following:

- a. Maintain, in operation, all existing electrical facilities and circuits required for active areas while this improvement work is in progress, furnish and maintain temporary circuits. This shall include the temporary relocation of existing electrical equipment and providing the temporary equipment and lighting.
- b. Furnish and install underground cable of the size and type specified in accordance with specifications, at the locations shown on the plans. Test all circuit after installation of new cables.
- c. Furnish and install all raceways and duct lines at the locations indicated and in accordance with specifications, ready for installation of cables.
- d. Provide modification to existing airfield lighting control and monitoring system (ALCMS).
- e. Provide power and control for airfield lighting.
- f. Installation of new airfield lighting cables, REILs, PAPI, edge lights, wind cones, signs, base cans and isolation transformers.
- g. Modification of existing airfield signage and concrete pad.
- h. Modification of existing base cans.
- j. Disposal of items identified for removal on Plans, to include but not limited to airfield lighting cables, isolation transformers, light fixtures and CCR's.
- k. Furnish and installation of constant current regulators (CCRs).
- l. Grounding of all equipment, enclosures, regulators, and conduits installed under this section as shown in the plans or as called for by the authority having jurisdiction.

m. Other items required to complete foregoing. The omission of expressed reference to any parts necessary for or reasonable incidental to the complete installation shall not be construed as releasing the Contractor from furnishing such parts.

All items of general work required, such as excavation, cutting, patching, etc., shall be included. The general work requirements are as follows:

a. Deactivation of power, security and telephone circuits for extended periods shall be by schedule established by the Owner. All work shall be scheduled to minimize the impact and duration of shutdowns. The Contractor shall keep the Engineer informed of scheduled work which will affect existing equipment and operations. A minimum of ten (10) working days advance notice shall be given to the Engineer and approval received for any disconnections or shutdowns. Any interruptions of power for active systems must be scheduled with and approved by the Engineer.

b. The plans are diagrammatic. Locations of equipment to be installed are shown in the plans, but the actual installation will depend on field conditions and the nature of the equipment furnished. When conditions which will adversely affect the installation become apparent, the Engineer shall be notified in writing.

The Contractor shall at all times keep the construction areas free from accumulations of waste material and rubbish, and prior to completion of work, shall remove any rubbish from and about the project, and all tools, reels, equipment, and materials not a part of the project. Upon completion of the construction, the Contractor shall leave the work and premises in a clean, neat, and safe condition satisfactory to the Engineer. The Contractor shall be responsible for the proper performance in all respects, in whole and in part, of the electrical equipment and for the mechanical installation of electrical equipment until acceptance of the entire work by the Engineer.

The Contractor shall protect all work, materials, and equipment from damage of any cause whatever, and shall provide adequate and proper storage facilities during progress of the work. The Contractor shall provide for safety and good condition of all work until final acceptance of the work by the Engineer, and replace all damaged or defective work, materials and equipment before requesting final acceptance.

All equipment shall be thoroughly cleaned of dirt, cement, bituminous materials, etc., and all corners scraped out and free of debris prior to installation.

### 1.3 APPLICABLE CODES

Applicable codes are as listed in Division 16 sections. The applicable electrical code for all of the Work is the National Electrical Code as currently adopted by the County of Kauai and State of Hawaii and all Division 16 specification Sections shall be referred to as the "Electrical Code."

### 1.4 REFERENCES

Work shall be in accordance with Federal Aviation Administration Advisory Circular No. 150/5370-10H, "Standards for Specifying Construction of Airports," as modified herein, other FAA Advisory Circulars and Specifications referred to herein, and other requirements as specified herein. The electrical work shall comply with latest adopted editions, codes and standards applicable to this section as follows:

ANSI C2, National Electrical Safety Code  
NEC, National Electrical Code (NFPA No. 70E)  
FAA, Advisory Circulars  
FAA, Orders  
NECA, Standard for Installation  
NEMA, Standard for Materials and Products  
NFPA No. 101, Life Safety Code  
UL, Underwriters' Laboratories  
Occupational Safety and Health Act (OSHA)  
Uniform Building Code (latest edition)  
Local Codes, if applicable

All work shall be performed in strict accordance with these contract specifications, drawings, and any instructions that may be furnished by the Engineer during execution of the work to aid in interpretations of said drawings and specifications. The Contractor shall keep these and all applicable specifications on file at his airport construction office. Electrical work shall be performed by an Electrical Contractor licensed in the State of Hawaii with at least five (5) years' experience in airfield lighting (in-pavement as well as elevated edge lighting) and signage installation. Workmen installing electrical systems shall have a current Apprentice license. Apprentices shall have a minimum of three (3) years' experience installing electrical systems.

All material furnished for this project shall be listed by Underwriters Laboratories wherever UL has a listing standard for that material.

### 1.5 SUBMITTALS

The specifications indicated the desired equipment and materials as to type and quality. Wherever proprietary names are listed in these specifications, it shall be

interpreted that the words “or approved equal” follow, unless otherwise specified. The words “or approved equal” shall be interpreted as meaning equal in every respect as determined by the Engineer.

Prior to the installation of any material and equipment and within 30 days of the administrative notice to proceed date, the Contractor shall electronically submit in pdf format to the Owner for approval manufacturers' brochures containing complete dimensional and performance characteristics, wiring diagrams, installation and operation instructions, etc., for the equipment listed in the individual 16000 Series specification Sections. Shop Drawings that are submitted incorrectly and the schedule delay resulting from this incorrect submission shall be the responsibility of the Contractor and no additional time will be provided under this contract due to the Contractor's error. The contractor shall allocate 14 calendar days for the review of these submittals by the Engineer.

The submittal shall be complete and made in one submission. Partial submissions will not be reviewed or considered. The only exception is the submittal for base cans and/or extensions. Due to the time-critical factor of this item, the Contractor may choose to submit this item the day of the notice to proceed for approval.

a. The Contractor shall submit to the Engineer for approval a complete list of all equipment and materials intended to be used on the job. The list shall include the following information for each item.

- (1) Name of Item
- (2) FAA Specification Number (If Any)
- (3) Manufacturer's Name
- (4) Manufacturer's Catalog Number
- (5) Size, Type and Rating

b. The Contractor shall submit a sufficient number of copies of the equipment and materials list for the Contractor's use and to allow the Owner to retain five (5) copies.

c. Before any orders are placed, and within five (5) calendar days after Engineer's approval of the equipment and materials list, the Contractor shall submit to the Engineer for written approval 5 copies of shop drawings for all electrical and lighting equipment and for all equipment and materials submittals. The shop drawings and equipment/materials submittals shall be complete showing all details.

b. The Contractor shall review, approve and sign all shop drawings prior to submitting same for Engineer's approval. All shop drawings received without the Contractor's signature will be subject to return without comment.

It shall be the responsibility of the Contractor to specifically point out any variation or discrepancy between the shop drawings or manufacturer's instructions he submits and the contract documents. Failure by the Contractor to identify in his letter of transmittal any variation, discrepancy, or conflict with the contract documents may result in the shop drawing or submittal to be returned to the Contractor for resubmittal.

e. The shop drawings shall show completely the work to be done, but approval by the Engineer shall not be construed as waiving any of the requirements of the contract and particularly shall not be construed as relieving the Contractor of full responsibility for fitting his equipment in the spaces provided; or from responsibility to fulfill the contract at no extra cost to the Owner within the completion time.

f. The Engineer will review all submittals and shop drawings and return them to the Contractor. If the Contractor's submittal or shop drawings are incomplete or the product submitted does not meet specification requirements, the Engineer will reject the submittal or shop drawing and the Contractor will be required to resubmit. Resubmittals shall address all comments from the Engineer. Partial resubmittals may be returned without action. The review of the first submittal and one resubmittal on any item will be made by the Engineer at no cost to the Contractor. The Contractor will be responsible for the Engineer's review costs for each subsequent resubmittal.

These costs will be charged to the Owner and back charged to the Contractor. Costs will be deducted from the Contractor's progress payments.

## 1.6 SUBMITTAL FORMAT

The submittal shall consist of manufacturer's brochures and cut sheets describing the equipment and materials the Contractor plans to incorporate in the work. These sheets shall be sequentially ordered by specification number with the reference specification number shown on the bottom right of each sheet. They shall be organized by the specification item number (L-100, L-108, etc.) with a tabbed divider sheet separating each item section. The submittal shall clearly show the equipment manufacturer's name, catalog number, size, type, and/or rating. The conformance to FAA criteria or other standards where called for shall be clearly indicated for each item. When used, cut sheets shall show all pertinent information by boldly circling all necessary data, as specified herein. Each sheet shall be dedicated to one piece of equipment, and all sheets shall be sequentially numbered (i.e., 1/50; indicating page 1 of 50 total pages). All sheets shall be 8-1/2" x 11" or 17" x 11". When these sizes are impractical, a folded 24" x 36" drawing may be substituted. All drawings shall be to scale. All sheets shall be bound in a 3-ring binder that is sized according to the total number of sheets. Each submittal shall show on the cover the complete job name and number, date,

contractor's name, and the words: "Electrical Submittal". A checklist showing all required and proposed submittals shall be prepared by the Contractor and submitted to the Engineer within seven (7) days after the preconstruction conference.

Samples of conduit, duct, fixtures, fittings, cables, tapes, etc., may be required by the Engineer or required in these specifications. After they have been reviewed, samples will be returned in tested condition to the Contractor. In the event any items of material or equipment contained in the list fail to comply with specification requirements, such items will be rejected. All rejected items shall be amended to meet the criteria and then resubmitted for approval by the Engineer.

Where materials or products specified herein are designated by manufacturer's name, any request to substitute materials or products other than those specified shall be accepted by the Engineer during the bidding period, as specified in the Instructions to Bidders. Burden of proof of equality of proposed substitutions will be the responsibility of the Contractor.

Substitutions of materials referenced herein is allowed provided it meets or exceeds all specification requirements and is equal to or better than specified item. Any substitution shall be included in the submittal package. Manufacturer's part numbers are provided for reference only.

Shop drawings and catalog cuts for substitute materials shall clearly specify compliance with and/or deviation from specified material. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as", and "achieve the same end use and results as materials formulated in accordance with the referenced publications". Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance. Review of shop drawings and catalog cuts shall not release Contractor from complying with intent of drawings and specifications.

#### 1.7 STANDARD INCIDENTAL WORK

The drawings, which constitute an integral part of this Contract, shall serve as the working drawings. Information was obtained using as-built information and shall be verified. They indicate the extent and general layout of the lighting and signing system, arrangement of circuits, cables through ducts, connections to existing circuit cables, and other work. Field verification of scale dimensions is required to determine actual locations, distances, and levels. The Contractor shall research in the field the exact routing and identification of all circuits which extend through, serve or are affected by the area where work is to commence.

No extra compensation will be allowed because of minor differences between

work shown on the plans and field conditions. The Contractor shall check the plans and specifications and, if any portion of the work is found to be omitted, unclear, or in error, the Contractor shall immediately notify the Engineer. The directions of the Engineer shall be followed and the work completed accordingly.

- a. The design drawings may be utilized in the preparation of the shop or working drawings showing the permanent construction.
- b. The plans and specifications are complementary and what is called for in either one shall be as binding as if called for in both.
- c. Where a disagreement exists between the plans and specifications, the item or arrangements of better quality or greater quantity shall be used.
- d. Any discrepancies between the drawings and field conditions must be resolved with the Engineer before proceeding. All agreements shall be verified in writing.
- e. "As-built" drawings covering equipment installed under previous contracts and which relate to this contract will be available for the Contractor. The airport cannot, however, guarantee the accuracy of these drawings. Those conditions which will affect the work under this contract should be verified prior to any design/fabrication/installation commitment.
- f. Detail dimensions shown on the plans are approximate and shall be field verified before construction. All differences shall be submitted to the Engineer in writing before Construction begins.

Prospective contractors shall, as part of their proposals, enumerate, identify and list conflicts that they discover to exist within the contract documents and/or between those documents and the rules, regulations, standards and codes of local utility companies and local, county or state governing bodies.

#### 1.8 PERMITS

Not Used.

#### 1.9 RECORD PLANS

The Contractor shall mark up a set of prints to show the as-built conditions which differ from the plans. All changes shall be recorded by a skilled draftsman with at least three (3) years experience. The Engineer will furnish a newly printed set of drawings to be used for this purpose. As-built drawings will be checked monthly by the Engineer for accurateness and partial payments will be withheld until the record drawings are completely updated. The mark-up set shall be kept at the site, and any changes or deviations shall be recorded within one week. The Contractor



shall furnish one as-built drawing set to the Engineer upon completion. This work shall be completed and accepted by the Engineer before approval of final payment.

#### 1.10 INSPECTION

The Contractor shall allow for inspection of the Work per General Requirements, and shall repair all defective work per General Requirements.

The Contractor shall arrange for all permit inspections.

#### 1.11 STANDARDS

As with all Work, the Contractor shall perform the electrical Work in compliance with all applicable laws, codes, regulations, and permits, and Section 01050, Control of the Work , the Contractor shall warrant that all of the Work "shall conform in all respects with all applicable requirements of Federal, State and local laws, licenses, and permits, the Contract Documents and all descriptions set forth therein, applicable construction codes and standards, and all other requirements of the Contract Documents."

As with all of the Work, the Contractor shall comply with all safety and security requirements described in the Contract Documents, specifically, but not necessarily limited to, the requirements of Section 01580, Temporary Facilities and Utilities, and Section 01800, Special Requirements for Contractors on the AOA.

Unless otherwise specified, materials and equipment used in the performance of the electrical construction shall be fully UL approved for the class of service for which they are intended.

#### 1.12 MANUFACTURER'S DIRECTIONS

The Contractor shall provide the Owner with complete instructions in the proper care and operation of the equipment installed under this contract. As part of the final inspection and final acceptance will not be given until the Owner's representative is made knowledgeable about the system.

The Contractor shall also collect and assemble into each of six (6) hardcover books the installation details, instructions, parts list, source of local supply, schematics of actual equipment and operations, and directions supplied by the manufacturer with all equipment. A complete set of approved submittal documentation shall be included in the final Maintenance and Operating Instructions. If cut sheets are included showing various models and features of the equipment supplied, the specific model and features shall be clearly indicated to show only the options of the equipment that are actually provided and installed. Final acceptance of the work will be withheld until such data has been presented complete to the Engineer for transmission to the Owner. The submittal checklist shall serve as an index and

checklist for these books. The O&M Manuals must be delivered to Owner at least two weeks before the start of training session.

#### 1.12 ENVIRONMENTAL CONDITIONS

The equipment areas are within the airfield. Ambient temperatures generally vary from 67 to 85 degrees F with strong direct radiation from the sun. Relative humidity will vary from 65 to 100 percent with condensation occurring. All areas may have wind-blown dust, sand, and rain occurring, including subject to salt spray.

#### 1.13 SAFETY RULES

The Electrical Safety Rules shall be observed and complied with in every detail, and any violation thereof shall be cause for immediate termination of the Contractor's authority to proceed with the work and recourse to his Surety for completion of the Project. The Electrical Safety Rules are as follows:

a. The Contractor shall be responsible for conforming to the safety requirements of the Airport.

b. Electrical circuits, operating over 300 volts, phase-to-ground, shall be de-energized before work is accomplished thereon. Work on energized systems shall be accomplished by trained personnel, properly insulated, and done with extreme caution.

c. Electrical circuits shall be considered de-energized only when one of the following conditions exists:

(1) Switches connecting subject circuit to the energy supply are observed in the OPEN position, with an air break, and safety-tagged and padlocked in the OPEN position;

(2) Electrically operated switches are visibly OPEN, blocked or racked in the OPEN position, and safety-tagged and padlocked OPEN;

(3) Whenever the supply circuit breaker is not visible and clearly identified, the circuit shall be grounded using bolted clamps and connectors capable of withstanding bolted fault conditions. The ground connection shall be safety-tagged before work thereon, when the ground connection is not within sight of the work area.

d. Use of Red Safety Tags:

Complex Lockout (Tagout). (Per. NEC, NFPA 70)

A complex lockout/tagout plan shall be required, submitted to the Airport for conformance, where one or more of the following exist:

- (1) Multiple energy sources (more than one)
- (2) Multiple crews
- (3) Multiple crafts
- (4) Multiple locations
- (5) Multiple employers
- (6) Unique disconnecting means
- (7) Complex or particular switching sequences
- (8) Lockout/tagout continues for more than one shift; that is, new shift workers

A person in charge shall be involved with a complex lockout/tagout procedure. The person in charge shall be at the procedure location.

The person in charge shall develop a written plan of execution in accordance with Airport policies and communicate that plan to all persons engaged in the job or task. The person in charge shall be held accountable for safe execution of the complex lockout/tagout plan. The complex lockout/tagout plan must address all the concerns of employees who might be exposed, and they must understand how electrical energy is controlled. The person in charge shall ensure that each person understands the hazards to which they are exposed and the safety-related work practices they are to use.

(1) Safety tags shall be filled out and connected to any switch or equipment opened for protection of personnel working upon circuits connected thereto.

(2) Safety tags shall be removed only by the employee who placed the tag, or by another employee designated in writing by the employee who placed the tag, to remove the tag. Removal of a safety tag placed by an employee not available at the time of need to remove may be authorized by the Electrical Superintendent or his designated representative, only after carefully checking that the circuit is ready to be energized.

(3) Equipment with a safety tag attached shall not be operated, and connections with a safety tag attached shall not be changed.

(4) Insulated cables, operated at over 300 volts to ground, shall be handled when energized only with rubber gloves tested to 15,000 volts.

(5) Insulated cables, which have been in operation, shall be cut

only with a grounded cable shears, or shall be grounded by driving a grounded sharp tool through the shielding and the conductors before cutting.

(6) Ladders used in any electrical work shall be of wood or fiberglass construction.

#### 1.14 LOCKOUT/TAGOUT PROCEDURES

Each complex lockout/tagout must be under the direct control of a single person in charge who is identified in a written plan. The person in charge must be assigned and must accept the responsibility of ensuring that an electrically safe work condition is established before any work task associated with the job can begin. The person in charge also must accept the responsibility of ensuring that all people who are assigned to the job are accounted for before the electrically safe work condition is removed.

A written plan must identify each step required to install lockout and tagout devices. To clearly establish the authority of the person in charge, the plan must be reviewed with or by all affected employees. The plan must identify the following:

- The disconnecting means
- Who will install lockout/tagout devices?
- How the absence of voltage will be verified
- How employees will be accounted for before, during, and after the work is complete

The complex lockout/tagout procedure shall vest primary responsibility in an authorized employee for a set number of employees working under the protection of a group lockout or tagout device (such as an operation lock). The person in charge shall be held accountable for safe execution of the complex lockout/tagout.

The person in charge must be both a qualified person and an authorized employee. Additional employees often are assigned to an area to provide sufficient manpower to complete all necessary work tasks while a shutdown is under way. Contract employees or other temporary employees might be unfamiliar with the location of electrical circuits and disconnecting means. The person in charge is responsible for ensuring that no employee, including each temporary employee, is unnecessarily exposed to an electrical hazard.

The person in charge must understand that he or she is accountable for generating, implementing, and monitoring the implementation of the plan.

Each authorized employee shall affix a personal lockout or tagout device to the

group lockout device, group lockbox, or comparable mechanism when he or she begins work and shall remove those devices when he or she stops working on the machine or equipment being serviced or maintained.

1.15 CONSTRUCTION SEQUENCING The Contractor shall notify the Engineer within 24 hours of completion of each task completed as described below:

a. The Contractor shall install all lights and fixtures, and test them in the presence of the Engineer. Any and all lights which fail to light correctly shall have new lamps installed, or work as required to correct the problem.

1.16 WARRANTIES AND GUARANTEES

The Contractor shall provide a written 1-year warranty guaranteeing all work installed under this contract. It shall cover all parts and labor against defective parts or workmanship necessary to repair or bring into proper operation any equipment including, but not limited to, fixtures, transformers, regulators, panel boards, transformers, circuit breakers, conduit system, pull boxes and base cans. The regulators shall be guaranteed under the terms of the manufacturer's and dealer's standard warranty for a period of two years and shall cover full parts and labor. The warranty shall start upon the acceptance of all work as accepted by the Engineer. Final payment will be withheld until receipt of the warranty by the Engineer.

PART 2 PRODUCTS

2.1 GENERAL

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

Manufacturer's certifications shall not relieve the Contractor of the Contractor's responsibility to provide material in accordance with these specifications and acceptable to the Airport.

All materials and equipment used in construction shall be submitted to the Engineer for approval prior to ordering equipment.

All materials and equipment used in construction shall be sufficient, in the opinion of the Airport, to determine compliance with the plans and specifications. The Airport reserves the right to reject any and all equipment, materials, or procedures, which, in the Airport's opinion, does not meet the system design and the standards and codes.

Materials and equipment shall be as specified herein. When materials are used that are not specifically designated herein, they shall be in accordance with the best industry standards and practices for equipment of this type. All components and

parts shall be suitable for operation under the environmental conditions specified herein. Metal parts shall be either inherently corrosion-resistant or shall be suitably protected to resist corrosion or oxidation during extended service life.

The Contractor shall supply material for electrical and lighting systems such that all components of a given system are of the same manufacturer; for example, all transformers shall be from one manufacturer. All lights and series isolation transformers shall be from one manufacturer to minimize the number and types of spares.

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

Should the Contractor find any discrepancies in or omissions from any of the documents or be in doubt as to their meaning, he shall advise the Engineer who will issue any necessary clarification within a time period which does not disrupt the progress of the work.

Should any discrepancy arise from the failure of the Contractor to notify the Engineer, the higher quality or larger quantity of item shall prevail. The Engineer shall make the final interpretation and judgement.

In the event of a discrepancy between small scale drawings and large scale details, or between drawings and specification, on which is in violation of any regulations, ordinances, laws or codes, the discrepancy, if known by the Contractor, shall be immediately brought to the attention of the State for a decision before proceeding with the particular work involved. Work carried out disregarding these instructions will be subject to removal and replacement at the Contractor's expense.

## 2.2 5kV CONDUCTORS

Underground 5kV airfield lighting cables shall conform to FAA Specification Item L-108, as modified in Section 16108, Underground Power Cable for Airports .

## 2.3 PARTS RATING

All parts shall be of adequate rating for the application and shall not be operated beyond the parts manufacturer's recommended ratings.

## 2.4 SALVAGE

Except as otherwise specified or indicated on the plans, all electrical materials and equipment to be salvaged or stored shall become the property of the Authority, and shall be moved by the Contractor to a site at the Airport designated by the Engineer

at no additional cost to the Authority. All wastes such as removed asphalt concrete and excess dirt, shall be disposed of, as directed by the Engineer, including disposal on-site.

## 2.5 TESTING

All materials and finishes are subject to testing. Material inspection and testing and strength tests on the concrete will be performed by the Airport at no expense to the Contractor other than material used. The Contractor shall assist the Engineer in obtaining samples during the course of construction work. The testing of electrical equipment shall conform to the description of the individual specification sections including those listed in Section 3.9 of these Specifications.

It shall be the Contractor's responsibility to demonstrate to the satisfaction of the Airport that the lighting circuits are continuous and free from short circuits and unspecified grounds, that circuits are properly connected and operable. The Contractor shall megger all existing runway and taxiway field cables and shall record and report all readings to the Engineer for cable megger readings both before modification and after. The Contractor shall provide all labor, equipment and materials.

## 2.6 INSPECTION

The Contractor shall provide for electrical inspections by the authority having jurisdiction. No work shall be concealed or enclosed until after inspections. If work is concealed or enclosed without inspection and approval, the Contractor shall be responsible for all expense and work required to open and restore the concealed area in addition to all required modifications.

## 2.7 HARDWARE CORROSION PROTECTION

In order to prevent deterioration due to corrosion, all bolts, nuts, studs, washers, pins, terminals, springs, hangers, and similar fastenings and fittings shall be of an approved corrosion-resisting material and/or be treated in an approved manner to render it adequately resistant to corrosion. All hardware such as cap screws, set screws, tap bolts, nuts, washers, etc., shall be of the type recommended by the manufacturer, or if a manufacturer's recommendation is not available, shall be stainless steel type 304, SAE grade 2, if they are used outdoors unless specified otherwise on the plans. Brass, bronze, or hot-dip galvanized ferrous hardware will be considered for indoor use. All bolts, screws, nuts, etc., used on the centerline light units or any other units where vibration from aircraft operations could loosen the bolts, as directed by the Engineer, shall be coated with a layer of "Locktight #242" or approved equal. All other bolts, screws, nuts, etc., used on edge lights, signs or other units shall be coated with a layer of "Neversieze" compound or approved equal as directed by the Engineer. Locktight #242 and Neversieze can be obtained from most electrical supply houses and from many automotive shops.

## PART 3 EXECUTION

### 3.1 GENERAL

For the requirements regarding general information, including but not limited to, utility locations and verifications, accuracy of the Plans, clean up requirements, and inspections, the Contractor shall refer to the General Requirements all other Sections of the Plans and the Specifications.

All work shall be performed in strict accordance with these contract specifications, drawings, and any instructions that may be furnished by the Engineer during execution of the work to aid in interpretations of said drawings and specifications. The Contractor shall keep these and all applicable specifications on file at his airport construction office. Electrical work shall be performed by an Electrical Contractor licensed in the State of Hawaii with at least five (5) years' experience in airfield lighting (in-pavement as well as elevated edge lighting) and signage installation. Workmen installing electrical systems shall have a current Apprentice license. Apprentices shall have a minimum of three (3) years' experience installing electrical systems.

Should the Contractor find any discrepancies in or omissions from any of the documents or be in doubt as to their meaning, he shall advise the Engineer who will issue any necessary clarification within a time period which does not disrupt the progress of the work.

Should any discrepancy arise from the failure of the Contractor to notify the Engineer, the higher quality or larger quantity of item shall prevail. The Engineer shall make the final interpretation and judgement.

In the event of a discrepancy between small scale drawings and large scale details, or between drawings and specification, on which is in violation of any regulations, ordinances, laws or codes, the discrepancy, if known by the Contractor, shall be immediately brought to the attention of the State for a decision before proceeding with the particular work involved. Work carried out disregarding these instructions will be subject to removal and replacement at the Contractor's expense.

All cable installations shall comply with FAA Specification Items L-108 as modified in Section 16108, Underground Power Cable for Airports.

### 3.2 INSTALLATION METHOD

The methods used for the installation of electrical system and equipment shall conform to the National Electric Contractors Association (NECA) published "Standard of Installation except where specifically specified or shown otherwise, and to the requirements of the National Electrical Code and its revisions as



adopted by the local agency having jurisdiction.

All electrical materials, construction methods, and installation shall be in accordance with applicable Federal Aviation Administration's Advisory Circulars including amendments, the National Electrical Code, and the American National Standards Institute Standard C2.

Workmanship shall be consistent with the best commercial practices for installations of this type.

The workmanship shall be first class and in accordance with the highest standards for the electrical industry. The installations and adjustments shall be by competent electricians. The responsibility for the correct and satisfactory installation and operation of all materials and equipment required herein shall rest with the Contractor. Before any equipment is ordered, a complete schedule of materials and detailed shop drawings covering all items of equipment and brochures of the materials proposed for installation shall be submitted for approval by the Engineer as described in this section.

Minor changes in the locations of fixtures and equipment shall be made prior to rough-in at the direction of the Engineer and at no additional cost to the Agency.

The equipment shall be installed with ample space allowed for removal, repair or changes to equipment. Ready accessibility to removable parts of equipment and to wiring shall be provided without moving other equipment which is to be installed or which is in place.

Contractor shall coordinate with Operations and Maintenance at the end of each daylight work shift to verify that all temporary airfield lighting circuits are operational. Contractor shall provide all labor and material for this work.

Contractor shall provide and maintain on hand sufficient equipment required to provide temporary lighting and circuit extensions. This includes, but is not limited to, light fixtures, transformers, bases, two-inch conduit, L-824 cable and L-823 connectors.

All runs shall be as continuous as possible with no splices permitted between terminations except where noted in the drawings and except where required by lengths supplied (normally 2,000 feet maximum). Locations of splices to be approved by the Owner. The Contractor, in pulling cables through ducts and/or conduits, shall not exceed the maximum allowable tension values for the cables as specified in FAA C 1391.

Any cable that is indicated on the project plans for direct earth burial shall be unreeled in place in the open trench or unreeled near the trench and carefully placed

in the trench bottom. Pulling the cable into the trench by dragging over the ground will not be permitted.

A cable slack loop of 6 feet,  $\pm 6$  inches shall be left on each end of cable runs and at all points where cable connections are brought above ground. The slack loop shall be installed at the same minimum depth as the cable run. Loops shall have no bends with an inner radius less than twelve times the outside diameter of the cable.

### 3.3 SITE CONDITIONS

At least five (5) working days prior to commencing construction operations in an area which may involve underground utility facilities, the Contractor shall notify the Engineer and the owners of each underground utility facility shown on the plans.

The existences of any known buried wires, conduits, pull boxes, ducts, or other facilities is shown in a general way only. It will be the responsibility of the Contractor, with the help of Airport personnel, to visit the site and make exact determination of the existence and location of any facilities prior to commencing any work. The Contractor will be responsible for making the exact determination of the location and condition of such facilities. A toll-free number for Hawaii One Call Center (“HOCC”) is (866) 423-7287. The Contractor is required to call this number and contact the Airport’s designated representative 48 hours in advance before performing excavation work within the project site. Any and all costs shall be paid for by the Contractor.

All items damaged by the Contractor's workers or equipment shall be replaced immediately at the Contractor's expense.

During the progress of work, all rubbish, waste lumber, displaced materials, etc. shall be removed as soon as possible and upon completion of the work, the Contractor shall remove from the State’s property and from all public and private property, at his own expense, all temporary structures, rubbish and waste material resulting from his operations.

### 3.4 CABLE REMOVAL

Prior to removing stuck/jammed cable(s) the following sets of procedures shall be followed before cable(s) can be removed from existing ductbank/conduit. The following work listed below shall be incidental to the removal and installation of airfield lighting cable.

- a. Using “compressed air” fill the existing conduit from both ends with cable loosening lubricant as manufactured by American Polywater Corp (CableFree

Loosener Cat #CF-128) , or approved equal. The applied loosener shall remain in conduit for 24 hours minimum before prior to cable removal.

b. Minimum amount of CableFree Loosener shall be calculated by the following, all other approved equal manufacturer's shall provide similar recommendation:

$$Q = 0.2 \times L \times D$$

Q = quantity in quarts, L = length of conduit (ft.), D = inside diameter of the conduit (in.)

c. Where initial application of cable loosener does not successfully aid in removal of cable(s), a second application shall be applied using same method as listed in 3.4 (a).

d. Use proper pulley rig setup inside junction structure for cable removal.

Roto-rooter conduit for stuck cable(s) if necessary, where second of attempt of cable loosener is not successful.

### 3.5 INSPECTIONS

All Electrical Work shall be subject to inspection and approval of the Federal Aviation Administration (FAA). In addition to any required inspection, the Engineer will inspect the system during the course of construction. The Contractor shall not cover up any work until inspected and approved by the Engineer, and, if required, by code enforcement inspectors.

### 3.6 NIGHT WORK LIGHTING

The Contractor, at its own expense, shall provide all temporary construction lighting installations as required for the performance of night work. The temporary installation shall be in accordance with all safety and electrical requirements requisite to this type of installation. Temporary lighting shall not hamper Control Tower operations.

The Contractor shall set up such installations as required to conform to runway and taxiway safety requirements.

### 3.7 ELECTRICAL SHUTDOWNS

For Work that will require an interruption of power or shutdown of any circuit, the Contractor shall schedule and submit a request to the Engineer at least one week before the proposed shutdown. The Contractor shall endeavor to keep such the downtime to a minimum and shall submit schedules that are mutually agreeable to all parties. The Contractor shall restore power to light circuits at the end of each

construction shift in accordance with Lockout/Tagout Procedures section 1.14 of these Specifications.

### 3.8 IDENTIFICATION

Comply with all electrical identification as indicated in Section 16108, Underground Power Cable for Airports.

Conductors, panelboards, switches, circuit breakers and motor controllers shall be identified as per FAA-C-1217, Sections 4.6.4.2.4 and 4.16. Cable tagging and markers shall be identified as per FAA-C-1391, Sections 3.5.1 and 2.

Transformers and junction boxes shall be identified by nameplate of nonferrous metal or rigid plastic, engraved with 3/8 inch high lettering with information as per FAA-C-1217, Section 4.16.

### 3.9 TESTING

Submit equipment and materials list and shop drawings as per FAA-C-1217, current edition, Section 5.1. Perform testing as per FAA-C-1217, Section 5.3 and FAA-C-1391, Section 4. Pretest all cable on the reel prior to installation and provide a copy of the test results to the Port.

The Contractor shall test the installed airfield lighting and miscellaneous power cables prior to the start of and at the completion of this project. The results of the testing shall be provided to the Port for review and acceptance. The Contractor shall be responsible for repairs or replacement of any cable found defective after installation.

The Contractor is responsible for making all necessary corrections to any deficiencies made evident by the test results.

Installation tests in addition to all tests contained in other L-Series Items shall be provided as follows:

Item	Test Required the Contractor or Independent Testing Service to Perform	Manufacturer's Rep. Present?
5 kV Rated Airfield Lighting and Power Cables (Newly Installed in This Project)	Megger check at 1000 volts at the completion of installation. Test every circuit for conductor-to-ground and conductor-to-conductor (between circuits) insulation resistance. Tabulate test results and give to the Port for acceptance. The readings must be greater than 100 megohms for the Port's acceptance of the installation Work.	No
600 V Rated Power Cables (Newly	Megger check at 500 volts at the completion of installation. Test every circuit for conductor-to-ground	No

Installed in This Project)	and conductor-to-conductor (between circuits) insulation resistance. Tabulate test results and give to the Port for acceptance. The readings must be greater than 100 megohms for the Port's acceptance of the installation Work.	
5 kV Rated Airfield Lighting and Power Cables – Existing affected by this project (All Circuits Emanating from the Lighting Vault Modified in This Project)	Megger check at 1,000 volts prior to the start of and at the completion of installation. Test every circuit for conductor-to-ground and conductor-to-conductor (between circuits) insulation resistance. Test results after completion shall match or exceed the pre-start of construction test results.	No
Airfield Light Fixture	Examine each light fixture prior to installation to ensure that lenses, where required, are properly fitted, that there are no signs of physical damage to the fittings, and that the lamps are appropriately sized. Check the fixture bolts to ensure that they are properly torqued to manufacturers and FAA requirements and affirm in writing.	No

The Contractor shall furnish all necessary equipment and appliances for testing the underground cable circuits after installation. The Contractor shall test and demonstrate to the satisfaction of the Engineer the following:

- a. Initial testing shall be performed prior to construction to establish the existing baseline. A final test shall be performed after the construction is completed to compare with the initial results to determine if the installation/improvements are acceptable.
- b. That all lighting or power (FAA and Airfield lighting) circuits are continuous and free from short circuits. Insulation resistance of all circuits shall not be less than 100 megohms.
- c. That all circuits are free from unspecified grounds.
- d. That the insulation resistance to ground of all newly installed non-grounded series 5 kV lighting circuits is not less 500 megohms.
- e. That the insulation resistance to ground of all newly installed non-grounded conductors of multiple circuits is not less than 200 megohms.
- f. That all circuits are properly connected in accordance with applicable wiring diagrams.

- g. That insulation resistance value of reconnected circuits is not less than previously tested, prior to disconnection.
- h. That all circuits are operable. Tests shall be conducted that include operating each control not less than 10 times and the continuous operation of each lighting and power circuit for not less than ½ hour.
- i. That the impedance to ground of each ground rod does not exceed 25 ohms prior to establishing connections to other ground electrodes. The fall-of-potential ground impedance test shall be utilized, as described by ANSI/IEEE Standard 81, to verify this requirement.
- j. Shall notify the Engineer of insulation resistance values less than 50 megaohms.
- k. Two copies of tabulated results of all cable tests performed shall be supplied by the Contractor to the Engineer for review and approval. Where connecting new cable to existing cable, ground resistance tests shall be performed on the new cable prior to connection to the existing circuit.
- l. There are no approved "repair" procedures for items that have failed testing other than complete replacement.

#### PART 4 MEASUREMENT AND PAYMENT

##### 4.1 METHOD OF MEASUREMENT

All work under this section will not be measured for payment.

##### 4.2 BASIS OF PAYMENT

Items covered by this section will be paid by lump sum. The contract price paid shall be for full compensation for furnishing and placing all materials and all labor, equipment, tools, and incidentals necessary for each of the construction phases.

Payment will be made under:

<u>Item No.</u>	<u>Description</u>	<u>Unit</u>
16050.1A	Electrical Demolition and Removal (Phases 0 through 3)	Lump Sum
16050.1B	Electrical Demolition and Removal (Phase 4)	Lump Sum

END OF SECTION 16050