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DIVISION 2 - SITE CONSTRUCTION

SECTION 02100 - DEMOLITION AND REMOVAL

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following for demolition and removal:
 - 1. Furnish all materials, labor and equipment necessary to demolish and remove all existing structures, and appurtenances as shown in the drawings and as specified herein.

1.02 GENERAL

- A. Condition at Site:
 - 1. Visit the site, examine and note all existing conditions and extent of work involved for completion of this work.
 - 2. Accept obvious conditions and extent of work involved for completion of this work.
 - 3. Exercise every precaution to preserve and protect from damage all existing structures, plants, trees, walls, private and public utilities above and below ground, etc., that are to remain. Repair any damage to the satisfaction of the Contracting Officer.
- B. Permits, Notices, Etc.:
 - 1. Procure and pay for all necessary permits or certificates required in connection with this work.
 - 2. Serve proper notices and consult with the Contracting Officer regarding any temporary disconnections of electrical or other utility lines which may interfere with this work. Properly disconnect all such lines where necessary before commencing with the work.
- C. Existing Utility Lines:
 - 1. Existence of underground utility lines other than those shown is not definitely known. Should any be encountered, immediately notify the Contracting Officer and follow his direction as to procedure at no additional cost to the State of Hawai'i.

1.03 STANDARD REFERENCES

- A. "Hawai'i Standard Specifications for Road and Bridge Construction," dated 2005 (paragraph concerning measurements and payment in the section are not applicable to this project) and all related revisions and amendments.

Removal of Structures and Obstructions

Section 202

PART 2 - PRODUCTS

2.01 MATERIALS

- A. No asbestos containing materials or equipment shall be used under this section. The Contractor shall ensure that all materials and equipment incorporated in the project are asbestos-free.

PART 3 - EXECUTION

3.01 DEMOLITION AND REMOVAL

- A. Execute all work in an orderly manner, with proper safety precautions observed at all times. Provide warning signs, lights, barricades, etc., as required or as directed by the Contracting Officer.
- B. Demolish all improvements indicated on the drawings completely on the site.

3.02 CONTRACT ZONE LIMITS

- A. The Contract Zone Limits shown on the drawings indicate only in general, limits of the work involved. Perform any and all necessary and incidental work which may fall outside of these demarcation lines. Confine all activities within the Contract Zone Limits and do not spread equipment and materials indiscriminately about the area.

3.03 DUST CONTROL

- A. Keep the work area thoroughly wetted down to prevent dirt and dust from rising. Provide all waterlines required for this purpose. Grade to fill all depressions or pits and to remove high spots after grubbing and removing all debris.

3.04 DEBRIS

- A. Remove all debris existing or accumulated from this work completely and promptly from the site to the satisfaction of the Contracting Officer. Burning of debris at the site is not permitted.

3.05 CLEANING

- A. Keep the premises clean, neat and orderly at all times. Promptly remove all tools, debris, materials, apparatus, temporary toils, lights, barriers, etc., from the site upon completion of this work.

3.06 FILLING VOIDS

- A. Completely fill below-grade areas and voids resulting from demolition of structures.
 - 1. Use satisfactory soil materials as defined in ASTM D 2478, consisting of stone, gravel, and sand, free from debris, trash, roots, and other organic matter.
 - 2. Prior to placement of fill materials, ensure that areas to be filled are free of standing water, trash and debris.
 - 3. Place fill materials in horizontal layers not exceeding 6 inches in loose depth. Compact each layer at optimum moisture content of fill material to a density equal to original adjacent ground, but not less than 90 percent density when

tested in accordance with ASTM D 1556, unless subsequent excavation for new work is required.

4. After fill placement and compaction, grade surface to meet adjacent contours and to provide flow to surface drainage structures.

END OF SECTION 02100

SECTION 02740 - FLEXIBLE PAVEMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following for flexible pavement:
 - 1. Furnish all labor, materials, tools, equipment and related items necessary to complete, in place, asphalt concrete pavement for repaving of the parking lot for installation of the septic tank in conformity with the dimensions and details shown on the plans.

1.02 STANDARD REFERENCES

- A. "Hawai'i Standard Specifications for Road and Bridge Construction," dated 2005 (paragraph concerning measurements and payment in the section are not applicable to this project) and all related revisions and amendments.

Aggregate Base Course	Section 304
Asphalt Concrete Pavement	Section 401
Aggregates	Section 703

- B. City & County of Honolulu "Standard Specifications for Public Works Construction," dated September 1986, and "Standard Details for Public Works Construction," dated September 1984, as revised, except as amended on the drawings and/or in the specifications herewith (paragraphs concerning measurements and payments in the sections are not applicable to this project).
- C. "Geotechnical Engineering Exploration, Fort Ruger Buildings 90, 90C & 90D Improvements" by Geolabs, Inc dated June 10, 2020

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Materials for roads shall be in accordance with the applicable sections of the references presented in Part 1.02 of this section.
 - 1. Recycled Glass:
 - a. Where recycled glass is available at a cost no greater than that of the equivalent aggregate, the aggregate base course and subbase course shall contain recycled glass as specified in Section 717 of the DO Standard Specifications.
 - 2. Mixes:
 - a. Roads and Parking Areas: **Mix No. V** shall be used.
 - 3. Prime Coat:
 - a. A **prime coat** shall be provided over newly constructed base course, where the longitudinal grade of the pavement is 8% or more, or where the asphaltic concrete pavement thickness is less than 4 inches.
 - b. Where a prime coat is provided, runoff shall be controlled, and adjacent work, property, utilities, waterways and other areas shall be protected against damage.

- c. The criteria for slope and pavement thickness shall be in accordance with the references presented in Part 1.03 of this section.
4. Tack Coat:
- a. A tack coat shall be provided in lieu of a prime coat in situations where the impact of the prime coat's objectionable odor, potential health hazards (especially with children) or the potential for the contamination of waterways in the event of runoff are likely.
- B. Root barrier shall be Typar Biobarrier, or approved equal, installed in accordance with the Manufacturer's directions and as shown in the plans.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The areas to be paved shall be staked out using wooden stakes on which the final finish elevations, base course and upgrade elevations are clearly marked. All stakes and elevations shall be approved by the Contracting Officer before any work is done.
- B. Roadways shall be installed in accordance with the applicable sections noted hereinbefore. Pavement section design shall match the existing pavement to suit design wheel load and traffic conditions.
- C. All project work entailing work within City, State or Federal right-of-ways shall adhere to the latest respective agency standards.
- D. Aggregate subbase course shall be used only if required due to soil and grading conditions.
- E. Tack coats shall not be applied to the sides of concrete curbs and sidewalks.
- F. Design slopes for accessible parking spaces, access aisles and accessible routes shall be less than the maximum slopes allowed by the applicable Accessibility regulations. Slopes installed in excess of the regulation maximum shall be considered defective work, and the contractor shall correct the finish slopes at his cost to the satisfaction and approval of the Contracting Officer.

3.02 COMPACTION TESTING

- A. Field density tests will be made by a certified testing laboratory, retained by the Contractor. The Contractor shall provide compaction tests at every lift and every 2,000 sf. The Contractor shall notify the Contracting Officer one (1) week prior to the start of fine grading for the roadway subgrade. The Contractor will be responsible for any corrective measures required as a result of inadequate compaction.

END OF SECTION 02740

SECTION 02750 - PAVEMENT STRIPING AND MARKINGS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following for pavement striping and markings:
 - 1. Furnish all labor, materials, tools, equipment and related items necessary to complete restriping and remarking of pavement damaged by construction activities.

1.02 STANDARD REFERENCES

- A. "Hawai'i Standard Specifications for Road and Bridge Construction," dated 2005 (paragraph concerning measurements and payment in the section are not applicable to this project) and all related revisions and amendments.

Pavement Markers, Striping and Markings Section 629

- B. City & County of Honolulu "Standard Specifications for Public Works Construction," dated September 1986, and "Standard Details for Public Works Construction," dated September 1984, as revised, except as amended on the drawings and/or in the specifications herewith (paragraphs concerning measurements and payments in the sections are not applicable to this project).

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Materials for roads shall be in accordance with the applicable sections of the references presented in Part 1.02 of this section.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install striping and marking of pavement in accordance with the applicable sections noted hereinbefore, plans and manufacturer's recommendations.

END OF SECTION 02750

SECTION 02820 – CHAIN LINK FENCE AND GATE

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following for fences and gates:
 - 1. Chain Link Fences
 - 2. Road Gates

1.02 CORROSION PROTECTION

- A. Manufacturer's specifications of Security fences shown on plans will govern this section.

1.03 STANDARD REFERENCES

- A. "Hawai'i Standard Specifications for Road and Bridge Construction," dated 2005 (paragraph concerning measurements and payment in the section are not applicable to this project) and all related revisions and amendments.

Chain Link Fences and Gates

Section 607

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Manufacturer's specifications of Security fences shown on plans will govern this section.

PART 3 - EXECUTION

3.01 INSTALLATION AND WORKMANSHIP

- A. Manufacturer's specifications of Security fences shown on plans will govern this section.

END OF SECTION 02820

DIVISION 16 - ELECTRICAL

SECTION 16000 - GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. As specified in Section 01001.
- B. Electrical Work: Provide all articles, materials, equipment operators, systems and services specified herein and, on the Drawings, and as normally required by accepted industry standard practices, including all labor taxes, fees, insurance, warranties and incidentals required to complete all electrical work.
- C. In general, the following work is included:
 - 1. Demolish existing electrical connections and equipment as indicated on the drawings.
 - 2. Provide, complete and in place, electrical systems as indicated in the Drawings and specified herein. Provide, complete and in place, exterior electrical and lighting systems.
 - 3. Provide saw cutting (where required), excavation, shoring, bracing, suitable backfill material, concrete encasement, backfilling, compacting, ac patching (where required) and concrete patching (where required) for complete duct system installation.
 - 4. Coordinate work with Hawaiian Electric Company, Hawaiian Telcom, the State of Hawaii, and the City and County of Honolulu electrical inspectors.
 - 5. Electrical systems shall include full cutoff exterior light fixtures, energy efficient lights, automated lighting system with occupancy sensors, and photovoltaic renewable energy systems where required.
- D. Furnish required submittals and samples, operations and maintenance manuals, and "As-built" Drawings.
- E. Coordinate work with other trades to avoid omissions and overlapping of responsibilities.
- F. Apply for, obtain and pay for all County fees, permits, licenses, utility fees, assessments and inspections required for this work.
- G. Pay for all temporary construction and testing power.

- H. Provide the necessary power, temporary power, man-power, equipment, and information as necessary to perform the tests and to provide the necessary submittals.
- I. Before bidding, visit project site, carefully review each section of the Specifications and all Drawings of this Contract. Verify details, report any error, conflicts or omissions to the Department of Defense (DOD) at least 10 calendar days before submission of bids for interpretation or clarification. If errors or omissions are not reported, Contractor shall provide necessary work at no additional cost to the DOD to properly complete intent of Specifications and Drawings. By submitting a proposal of the work included in this contract, the Contractor shall be deemed to have made such examination and to be familiar with and accept all conditions of the job site.

1.02 SUMMARY

This Section includes specifications for exterior electrical work.

1.03 INTENT OF SPECIFICATIONS AND DRAWINGS

- A. Specifications and Drawings are prepared in abbreviated form and include incomplete sentences. Omission of words or phrases such as “the Contractor shall”, “as shown on the drawings”, “a” and “the” are intentional. Omitted words and phrases shall be provided by inference to form complete sentences.
- B. Specifications and Drawings complement each other and what is specified, scheduled or mentioned on one shall be binding as if called for by both.
- C. Discrepancies and Interpretations:
 - 1. 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 DOD who will issue any necessary clarification within a time period which does not disrupt the progress of the work.
 - 2. All interpretation and supplemental instructions will be in the form of a written addendum to the Contract Documents.
 - 3. Should any discrepancies arise from the failure of the Contractor to notify the DOD, the higher quality or larger quantity of item shall prevail. The DOD shall make the final interpretation and judgment.
 - 4. In the event of a discrepancy between small scale drawings and large scale details, or between Drawings and Specifications, of 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 DOD 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.

1.04 DEFINITIONS

- A. Provide: "Furnish and install, test and deliver to the DOD in operating and ready to use condition."
- B. Wiring: "Provide all raceways, junction boxes, conductors, devices, protection equipment, installation of motor controllers (furnished by others) when required, etc., including testing for a complete, operative and ready to use electrical system."
- C. Equal: "Material, equipment or system, including all necessary labor, modifications and accessories satisfying the requirements of the contract documents, the design intent, and to provide features or have operating characteristics equal or better than that specified."
- D. Complete: "Furnish installation that is operative, tested, and ready to use and which satisfies the intent of the contract documents, including all necessary accessories and modifications."
- E. Contractor: "General Contractor responsible for all work shall assign work to Sub-Contractors. Except where noted, work of this section shall be assigned to the Electrical Sub-Contractor."
- F. HECO: Hawaiian Electric Company
- G. HTCO: Hawaiian Telcom
- H. Oceanic: Oceanic Time Warner Cable

1.05 QUALITY ASSURANCE

- A. Government and Utility Requirements: Comply with all requirements of the State of Hawaii, City and County of Honolulu, Disability and Communication Access Board (DCAB), and respective utility company rules and regulations.
- B. Specifications are accompanied by architectural, civil, mechanical, landscape, and audio-visual plans of the buildings, site, and diagrammatical electrical plans showing locations of luminaries, standards, outlets, feeder runs, devices and other electrical equipment. Locations are approximate and before installation, Contractor shall study adjacent construction details and make installation in the most logical manner. Prior to installation and at the direction of the DOD, relocate any device, equipment, feeder, or circuit within 10'-0" of the location presently shown without added cost to the DOD.
- C. Prior to start of the rough-in work, verify all dimensions and equipment sizes with the approved shop drawings including equipment furnished by others. Circuits and raceway routes are diagrammatic and may be altered in any logical manner. However, all changes from the contract documents shall be subject to review and acceptance of the DOD and indicated on the "As-built" Drawings.

- D. Feeders and branch circuits for equipment furnished by others were sized for the anticipate equipment. Verify electrical requirements of all equipment furnished by others prior to rough in and prior to ordering of the electrical distribution equipment. Re-size affected feeders and branch circuits at no additional cost to the DOD.
- E. Materials and Equipment: Materials and equipment shall conform to requirements of applicable technical specification sections, publications specified therein and shall be as shown on the drawings. Materials and equipment shall be new and shall be the product of manufacturers regularly engaged in the manufacture of such products.

All items shall essentially duplicate materials and equipment which have been in satisfactory use at least two years prior to bid opening and shall be supported by a service organization that is located reasonably close to the site of installation.

F. Substitutions:

1. Where items are specified by manufacturer's name or catalog number, substitutions require written permission by the DOD prior to bidding. Brand names, manufacturer's names and catalog numbers indicate the standard of design and quality required. List of substitute materials together with qualifying data shall be submitted for review at least twelve (12) working days before bid date. Failure to submit for review substitute materials prior to bidding shall mean that materials, as specified, will be provided. Substitute materials submitted and rejected shall not be resubmitted in any modified form.
2. Samples of proposed substitute items may be required and shall be submitted by the Contractor at his expense as soon as practicable after they are requested.
3. Burden of proof of equality of proposed substitutions will be the responsibility of the Contractor. Submittals shall be sufficiently detailed to permit evaluation of the proposed items. Inadequacy of submittals shall be sufficient cause to reject a proposed substitution.
4. All prospective bidders must submit descriptive information on proposed material for pre-bidding acceptance where an item is detailed but no manufacturer is named.
5. Costs to review any contractor submitted value engineering change proposals shall be paid by the Contractor.

- G. Prevention of Corrosion: All metallic materials shall be protected against corrosion. Exposed metallic parts of equipment, apparatus, devices, mounting hardware, and fasteners that are provided in damp, wet, or corrosive areas shall be constructed from 316 or 316L stainless steel. All such parts as boxes, bodies, fittings, guards and miscellaneous parts shall be constructed of 316 or 316L stainless steel. The Contractor shall not join dissimilar metals that will result in deterioration due to galvanic corrosion.

1.06 DEPARTURES

- A. Departures resulting from the substitution of materials or systems shall be accompanied by appropriate changes in all affected work of every trade and shall include stamped and signed drawings by a licensed engineer for any portion of the project requiring re-design. Such changes shall be done at no increase to the contract amount and shall be the responsibility of the Sub-Contractor or supplier responsible for the departures. Changes proposed by the Contractor shall be based on a system approach and may be allowed if implemented without decrease in quality, performance and operations, increase in utility costs or adverse effect on the available physical space to install the equipment. Such departures shall be submitted and noted in shop drawings for review and acceptance by the DOD. Departures initiated by other trades, requiring changes in the electrical system as well as other systems, shall be accompanied by appropriate changes to all affected work of every trade, at no increase in contract amount. Submission for departure shall be as follows:

EXAMPLE:

<u>Item</u>	<u>Manufacturer and Catalog Number Specified</u>	<u>Substitute Manufacturer and Catalog Number</u>
Cable	John Doe - No. 3200	King - No. 2200

- B. The General Contractor shall be responsible to coordinate, approve and select systems that do not impose unaccounted for impacts on the electrical work. It shall be understood that after the award of contract, all departures having electrical impact, unless otherwise noted, have been reviewed and approved by the General Contractor.

1.07 SUBMITTALS

- A. Submit in accordance with Section 01300 - SUBMITTALS. All submittals shall be reviewed and approved by the general contractor and the electrical contractor. Partial submittals or submittals lacking the general contractor's and electrical contractor's approvals will not be acceptable. Submit for approval six (6) complete sets of submittals as described below. Annotate descriptive data to show the specific model, type, option, and size of each item the Contractor proposes to furnish. Do not commence work until each system, including all the various components, have been approved. The DOD will review and approve all submittals. Before the materials are ordered or the work is commenced the shop drawings must be approved. All submittals shall be submitted to and reviewed by the LEED Administrator as necessary for the LEED documentation process.
- B. List of Materials and Equipment: Submit in accordance with Section 01330 - SUBMITTALS. These lists shall include manufacturer's names and material or equipment identification such as styles, types, or catalog numbers to permit ready and complete identification. Original catalog cuts or brochures shall be provided. Scanned or photocopied submittals will be rejected without review.

- C. Product Data: Shall be sufficiently comprehensive and detailed to permit evaluations, otherwise the item may be rejected, and shall include, as applicable, the following:
1. Original catalog cuts or brochures shall be provided. Scanned or photocopied submittals will be rejected without review.
 2. Each submittal shall contain an itemized list of each item being submitted. Each item shall be identified with the complete manufacturer's ordering number including all options.
 3. Dimension outlines of all enclosures.
 4. Dimension drawings of components such as switchboard, motor control center, panelboards, transformers, enclosed circuit breakers, safety disconnect switches, inverters, and generators.
 5. Scaled drawings showing the layouts and arrangement of equipment in all electrical rooms, telecom rooms, and generator rooms.
 6. Operating and electrical characteristics including interrupting ratings and impedances.
- D. Certificate of Compliance: Where required by the section specifying the equipment, the Contractor shall submit six (6) copies of certificates of compliance in accordance with the requirements of the GENERAL REQUIREMENTS. The certificates shall include but not be limited to factory test reports.
- E. Installation, Operation and Maintenance Data: Six (6) copies of installation, operation and maintenance data shall be submitted for equipment specified to require such data. The data shall be in the form of manuals and shall indicate instructions for operating, maintaining, repairing, recommended inspection points, periods for inspection, and all related spare parts in a practical, complete and comprehensive manner. The information shall be arranged in a logical, orderly sequence, including a general description of the equipment and significant technical characteristics.
- Test, adjustment and calibration information shall be furnished and identified to specific equipment. The installation, operation and maintenance data shall be as required by the General Requirements.
- F. Acceptance Requirements: Acceptance for material and equipment will be based on manufacturer's published data. Where materials or equipment are specified to be constructed and tested, or both, in accordance with the standards of the National Electrical Manufacturers Association (NEMA) or the American National Standards Institute (ANSI), the Contractor shall submit proof that the items furnished under this section of the specifications conform to such requirements. A certification or published catalog specification data statement to the effect that the item is in accordance with the referenced NEMA standard by a company listed as a member company of NEMA for the section whose standards cover the item under

construction, will be acceptable as sufficient evidence that the item conforms to the requirements of the National Electrical Manufacturers Association. A manufacturer's statement indicating complete compliance of each item with the applicable NEMA, ANSI or other commercial standard specified shall be submitted and will be acceptable proof of compliance. Conformance with the agency requirements does not relieve the item from complying with any other requirements of the specifications.

G. Nameplates:

1. General: In addition to standard manufacturer's nameplate, permanent corrosion resistant nameplates shall be provided for each enclosed circuit breaker, safety switch, panelboard, lighting contactor, inverter, telecom junction box, and other major pieces of equipment. Nameplates shall designate the function of the equipment for which they are used. The designation shall be submitted for review and acceptance with the shop drawings.
2. Material and Lettering: 1/16" thick, laminated plastic, black-white-black. Nameplate lettering shall be 1/4" high upper-case.
3. Fastening: Nameplates shall be fastened stainless steel (316) screws.
4. Hand lettering or stick-on embossed marking tape is not acceptable.
5. Provide laminated tape labeling for all new receptacles on coverplates. Identify associated panel name and circuit number.

H. Labels

1. Provide labels as required by the latest version of the National Electrical Code adopted by the County or City & County.
2. The labels shall be designed according to the following standards:
 - a. UL969 – Standard for Marking and Labeling Systems.
 - b. ANSI Z535.4 – Product Safety Signs and Labels.
 - c. NFPA 70 (National Electric Code) – Article 110.16.
 - d. NFPA 70E – Section 130.
3. Labels shall be provided for, but not limited to:
 - a. Available fault currents at the service equipment per 2014 NEC 110.24(A).
 - b. Arc Flash warning labels shall be provided per 2014 NEC 110.16 and 2015 NFPA-70E 130.5. The contractor shall attain all information required for the calculations, perform the calculations, and provide the labels at no additional cost.

- c. Source and location of feeder serving switchboards and panelboards per NEC 408.4(B).
 - d. Method utilized for conductor identification per 2014 NEC 210.5(C).
 - e. All telecommunication, telephone, data, and signal cables.
4. Label materials shall be provided similar to nameplates except that labels for wires, conductors, and cables shall be of the printed tape type.
- I. Factory Tests and Inspection:
- 1. The equipment furnished shall be inspected mechanically and electrically, and all manufacturers' routine factory tests shall be performed to verify conformance with the specified requirements. The test equipment and test methods shall conform to the requirements of standards specified. The contract price shall include cost of performing all tests.
 - 2. The Contractor shall furnish, at time of equipment delivery, six (6) certified copies of all test results.
- J. Equipment Guarantees: Installation shall be complete in every detail and ready for use. Any item furnished or provided by the Contractor developing defects within one (1) year after final acceptance by the DOD shall be replaced by materials, apparatus and parts including installation labor costs to make such defective portion of the completed system conform to the true intent and meaning of the drawings and specifications, without additional cost to the DOD. The Contractor shall guarantee all equipment provided from the date such equipment is accepted by the DOD, against defects in materials, design, performance and workmanship. Guarantees shall be supported by manufacturer's written warranties and shall be signed by an official of the manufacturer's organization. Replacement parts shall be delivered and repairs shall be made promptly upon receipt of notice of failure under normal and proper use and maintenance. All costs of replacement and repair shall be borne by the Contractor provided that a report substantiating such defect or failure to conform to specifications is promptly given to the Contractor.

1.08 CODES, REGULATIONS AND STANDARD SPECIFICATIONS

- A. Work shall conform to the Hawaii Revised Statutes, the Ordinances of City and County of Honolulu; the International Conference of Building Officials (ICBO) International Building Code (IBC); and the latest edition of National Electrical Code (NEC).
- B. Applicable rules, standards and specifications of following associations shall apply to materials, workmanship, and procedures:

American National Standards Institute (ANSI)

Illuminating Engineering Society of North America (IESNA)
National Electrical Manufacturer's Association (NEMA)
National Fire Protection Association (NFPA)
Underwriters' Laboratories, Inc. (UL)

1.09 ACKNOWLEDGEMENT

- A. By bidding on this project and or by providing this work the Contractor acknowledges that:
1. The Designer is not responsible for the means and methods employed by the Contractor and that the Contractor is responsible for his means and methods.
 2. The Designer is not responsible for job site and worker safety and that the Contractor is responsible for job site and worker safety.

1.10 WARRANTY

- A. Defective materials and workmanship shall be removed and replaced at no cost to the DOD. For period of one year after acceptance of work by DOD, materials and workmanship developing defects and malfunctions shall be repaired and/or replaced, to conform with intent of the specification and drawings, at no additional cost to the DOD.

PART 2 - PRODUCTS

2.01 MATERIALS

All materials shall be new, except as specifically noted, and shall bear the label of Underwriter's Laboratories, Inc., wherever standards have been established and label service is normally and regularly furnished by the agency. See the respective technical sections for the electrical material specifications.

PART 3 - EXECUTION

3.01 MATERIALS AND EQUIPMENT PROVIDED BY THE CONTRACTOR

The electrical installation shall be complete and operable and shall conform to the requirements of the contract drawings. The Contractor shall provide all electrical equipment and materials, wiring, supports and such additional parts as are necessary to make the installation complete. All Contractor furnished materials and equipment are subject to review and acceptance by the DOD.

3.02 PROTECTION DURING STORAGE

Store all materials and equipment in a safe manner. Provide weather, dehumidification, and fire protection for all materials. Store all materials above grade to avoid damage by moisture. Cover all materials to avoid damage from sunlight.

3.03 PROTECTION OF WORK IN PROGRESS

All electrical materials and equipment shall be completely protected during installation. Equipment shall be securely protected against physical or chemical damage. In areas exposed to weather, materials unused at the end of each day's work shall be protected by weatherproofed installations. All unprotected conduits shall be sealed to prevent water and foreign debris from entering conduits. Damage to materials and equipment due to Contractor's neglect shall be repaired or replaced by and at the expense of the Contractor.

3.04 PROGRESS OF WORK AND COORDINATION

The Contractor shall prepare a schedule identifying the sequence of electrical work. The electrical work shall be coordinated with the work of other Contractors and other trades. The schedule shall be submitted prior to beginning installation and shall be subject to review and acceptance by the DOD.

3.05 RULES

The entire electrical installation shall conform to the applicable rules and regulations of the State Fire Code and the standards and publications specified in the technical sections.

3.06 COORDINATION

The contract drawings indicate the extent and general location and arrangement of equipment, conduit and wiring. Lighting fixtures, outlets and electrical equipment shall be located so as to avoid interference with architectural, mechanical and structural features. The DOD may request any device, equipment, circuit, or feeder to be relocated within 10'-0" of the location shown on the Drawings before installation is initiated and without increase in contract amount.

3.07 WORKMANSHIP

- A. All materials and equipment shall be installed in accordance with printed recommendations of the manufacturer and shall conform to the requirements of the contract drawings. The installation shall be accomplished by workers skilled in this type of work. For actual fabrication, installation and testing of the Electrical Work, use only thoroughly trained and experienced workmen completely familiar with items to be installed and with manufacturers' recommended methods of installation. In acceptance or rejection of installed work no allowance will be made for lack of skill on part of workmen.
- B. Inspection: Skill and competency of workmanship shall be subject to the approval of the State, and the City and County of Honolulu. The contractor shall open all electrical equipment, cabinets, junction boxes, and devices as required by the City and County of Honolulu or inspector for inspection. All equipment shall be de-energized prior to inspection unless voltage and current measurements are required. The Contractor shall be responsible for all electrical and arc flash safety at the project site.

3.08 FIELD TESTS

- A. After the installation is completed, and at such time the DOD may direct, the Contractor shall conduct field tests for acceptance by the DOD. When the tests are specified to be performed under the supervision of the equipment manufacturer, the Contractor shall cooperate with the DOD during tests and shall place at the manufacturer's disposal, all assistance, materials and services required to perform such tests. The tests shall be performed in the presence and to the satisfaction of the DOD. The Contractor shall furnish all necessary electric power, fuel, instruments, equipment, and personnel required for the tests and shall pay for all power and fuel.
- B. Insulation Tests: The insulation of all conductors shall be tested with a megger insulation tester. Submit results of tests to the DOD.
- C. Operating Tests: The equipment and systems shall be demonstrated to operate in accordance with the requirements of the technical sections in which the equipment or systems are specified.
- D. Ground Resistance Test: Test ground resistance by three-point method. Results of test shall be submitted to the DOD. Ground Resistance: Ground resistance measurements of each ground rod shall be taken and certified by the Contractor. Upon completion of the project, the Contractor shall submit in writing to the DOD, the measured ground resistance of each ground rod and grounding system, as well as the resistance and soil conditions at the time the measurements were made. Ground resistance measurements shall be made in normally dry weather, not less than 48 hours after rainfall, and with the ground under test isolated from other grounds.
- E. Test all 600 volt class conductors to verify that no short circuits or accidental grounds exist. Make tests using an instrument which applies a voltage of approximately 500 volts to provide a direct reading in resistance, and measure the insulation resistance from phase to phase and phase to neutral. All test results shall be recorded and submitted to the DOD.
- F. Wherever test or inspection reveals faulty materials or installation, Contractor shall take corrective action, at his own expense, repairing or replacing materials or installation as directed. The materials or installation shall then be retested.

END OF SECTION

SECTION 16050 – ELECTRICAL BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

As specified in Section 01001.

1.02 SUMMARY

- A. This section provides the specifications for general electrical work. See other specification sections for more detailed specifications related to specific electrical systems.
- B. The Contractor shall furnish all labor, materials, tools, equipment, electricity, fuel, shipping and delivery, and appliances required to provide all Electrical Work, complete, as indicated on the drawings and/or as specified herein. The drawings note various sizes of equipment as determined for basis of design; the electrical work, however, shall be installed to comply with the equipment furnished by the successful supplier and shall be based on the approved shop drawing submittals. The work shall include but not necessarily be limited to, the following:
 - C. Complete power distribution system.
 - D. Complete general use and special power systems.
 - E. Connection and testing of appliances and equipment furnished by others requiring electrical connections.
 - F. Before bidding on this work, carefully examine each of the drawings and the site. By submitting a proposal of the work included in this contract, the Contractor shall be deemed to have made such examination and to be familiar with and accept all conditions of the job site.

1.03 SUBMITTALS

- A. Submit in accordance with Section 01300 - SUBMITTALS.
- B. Shop drawings and catalogue 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 catalogue cuts shall not release Contractor from complying with intent of specification and drawings. Partial or incomplete submittals will be returned without review.

- C. Shop Drawings: Submit complete shop drawings and manufacturer's literature for the Department of Defense's (DOD) review before any work is ordered or fabricated. All submittals shall have the approval of the general contractor and the electrical contractor. Partial or incomplete submittals or submittals lacking the general contractor's and electrical contractor's approval will be returned without review. Submit in accordance with Section 01300 - SUBMITTALS. Submit manufacturer's literature for the following:
 - 1. Conductors
 - 2. Raceways
- D. As-Built Drawings: Submit as-built drawings as specified under Section 01700 - CONTRACT CLOSEOUT.

1.04 GUARANTEE AND CERTIFICATES

- A. Any item of material, apparatus, equipment furnished and installed, or constructed by the Contractor showing defects in design, construction, quality or workmanship within one year from the date of final acceptance by the DOD shall be replaced by such new material, apparatus or parts as may be found necessary to make such defective portion of the installation conform to the true intent and meaning of the specification and/or the drawings. Exceptions shall be fluorescent and incandescent lamps which shall be guaranteed for one half the manufacturer's listed life time. Such repairs or replacement shall be made by the Contractor, free of all expense to the DOD.

1.05 COORDINATION WITH UTILITY COMPANIES AND OTHER TRADES

During bidding and construction, Contractor shall coordinate his work with utilities, and other trades to avoid omissions and overlapping of responsibilities.

1.06 CODES, REGULATIONS AND STANDARD SPECIFICATIONS

- A. Work shall conform to latest edition of National Electrical Code.
- B. Applicable rules, standards and specifications of following associations shall apply to materials and workmanship:

- American National Standards Institute (ANSI)
- Illuminating Engineering Society of North America (IESNA)
- National Board of Fire Underwriters (NBFU)
- National Electrical Manufacturer's Association (NEMA)
- National Fire Protection Association (NFPA)
- Underwriters' Laboratories, Inc. (UL)

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General: All materials shall be new, except as specifically noted, and shall bear the label of Underwriters' Laboratories whenever standards have been

established and label service is normally and regularly furnished by the agency.

B. Raceways:

1. Conduits: EMT and galvanized rigid steel, 3/4" minimum diameter with compression or threaded fittings, respectively. Aluminum conduits shall not be used.
2. Non-Metallic Conduit: PVC Schedule 40 and sunlight-resistant epoxy resin coated fiberglass, wall thickness as indicated (ISO 9001: 2008 certified), 3/4" minimum diameter.
3. Reinforced Thermosetting Resin Conduit: NEMA Standard TC 14, UL 2515 IPS above Ground and 2515A Extra Heavy Wall standards, ISO 9001: 2015 Quality Control Management, Type AG, sunlight resistant, wall thickness as required to provide degree of protection suitable for installation location.
4. Flexible Conduit: 3/4" minimum, zinc-coated inside and outside; for damp, wet, moist, or corrosive areas -- liquid-tight with factory fittings and UV stabilized PVC jacket.

- C. Conductors: Conductors shall be copper, No. 12 AWG minimum; No. 10 AWG and smaller, solid and round; No. 8 AWG and larger, 7 or 19 strands concentric. All conductors No. 6 and smaller shall be types THW for interior use or RHW for exterior use. All conductors No. 4 AWG and larger shall be type THWN-2 for interior use; or RHW-2 or USE-2 for exterior use. Conductors used for fire alarm, sound system, and control wiring may be sized according to the system manufacturer based on their load and voltage drop calculations and code requirements. Conductors used to serve critical operations power systems (power systems for facilities or parts of facilities that require continuous operations for reasons of public safety, emergency management, national security, or business continuity) including but not limited to emergency power, HVAC, fire alarm, security, telecommunications, and signaling shall be a listed 2-hour electrical circuit protective system. Conductors installed on roof tops and exposed to sunlight shall be derated per NEC Table 310.15(B)(2)(b) or shall be type XHHW-2. Conduit sizes shall be increased as necessary to accommodate derated and type XHHW-2 conductors. Reduce conductor sizes at equipment terminations as required to accommodate maximum allowable conductor size accepted at equipment terminals per manufacturer's recommendations. Provide UL listed in-line reducer splice kit or UL listed cable reducing adapter plugs as required to reduce conductor sizes.

D. Device and Cover Plates:

1. Plates for interior flush construction shall be smooth reinforced plastic, with suitable hole(s) and color to match device. Plates for receptacles on Department of Education projects shall be brushed stainless steel.

2. Device covers outlets in damp, wet, or corrosive locations shall be weatherproof with lockable stainless steel (316) covers. Covers shall permit plugs to be connected without compromising the integrity of the protective nature of the cover while in use.
 3. Light switch plates for areas exposed to the elements, damp, or wet installations shall be neoprene gasketed cast aluminum, gray powder coat finish, with spring loaded neoprene gasketed flip-open lids.
 4. Plates for receptacles on emergency circuits shall be red.
 5. Plates for receptacles serving telecommunication loads on Department of Education projects shall be blue.
 6. Plates for receptacles shall be labeled with the name of the panelboard and circuit number serving the receptacle.
- E. Duct Sealant: Shall not affect physical or electrical properties of wire and cable. Shall meet NEC codes for raceway seals and be UL listed. Shall be capable of holding 15 feet waterhead pressure continuous and block up to 4 psi gas or vapor continuous. Polywater FST, or pre-approved substitute.
- F. Hardware, Supports, Backing, Etc.: All hardware, fasteners, supports, backing and other accessories necessary to install electrical equipment shall be provided. Wood materials shall be "wolmanized" treated against termites, iron or steel materials shall be galvanized for corrosion protection, and non-ferrous materials shall be brass or bronze. Installations in damp, wet, or corrosive locations shall be of stainless steel, 316.

PART 3 - EXECUTION

3.01 GENERAL

- A. Rules and Permit: The entire installation shall be made in strict accordance with the latest rules and regulations of the National Board of Fire Underwriters, the currently adopted edition of the National Electrical Code and the Electrical Branch of the local Building Department. The Contractor shall obtain and pay for the electrical permit as required by local laws and rules. All work shall be inspected by the proper local authorities as it progresses. The Contractor shall pay all inspection fees and shall deliver certificates of completion and inspection to the City and County of Honolulu before final payment will be made. Costs of permits and inspection fees shall be included in the Contractor's bid price.
- B. Construction Methods: Construction shall conform to construction practices as recommended by the American Electricians Handbook by Croft (latest edition), Edison Electric Institute, National Electrical Code, National fire Protection Association, National Electrical Safety Code and applicable instructions of manufacturers of equipment and material supplied for this project.
- C. Materials and Workmanship: All labor and materials of every kind shall be subject to the approval of the DOD, who shall be afforded every facility for

ascertaining the competence of such labor and examining such materials as they may deem necessary. Concealed work, handholes, and enclosures shall be reopened / opened at random as directed during inspections by the DOD. Materials shall be new and shall bear the listed label of the Underwriters' Laboratories, Inc. Brand names and catalog numbers used in this specification indicate the standards of design and quality required. Substitution of other brands or catalog numbers shall conform to the requirements in the Bidding Documents. All high voltage work shall be performed by qualified electricians certified to work on high voltage systems.

- D. Record Drawings: The Contractor shall maintain an accurate and adequate record of each change as it occurs, regardless of how ordered.
- E. Drawings and Specification: This specification is intended to cover all labor, materials and standards of workmanship to be employed in the work indicated on the Drawings and called for in the specification or reasonably implied therein. The Drawings and specification supplement one another. Any part of the work mentioned in one and not represented in the other, shall be done the same as if it has been mentioned in both. The Contractor shall not make alterations in the Drawings and specification.
- F. Discrepancies and Interpretations:
 - 1. 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 DOD who will issue any necessary clarification within a time period which does not disrupt the progress of the work.
 - 2. All interpretation and supplemental instructions will be in the form of a written addenda to the Contract Documents.
 - 3. Should any discrepancy arise from the failure of the Contractor to notify the DOD, the higher quality or larger quantity of item shall prevail. The DOD shall make the final interpretation and judgment.
 - 4. In the event of a discrepancy between small scale drawings and large scale details, or between the 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 DOD 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.
- G. Symbols: The standard electrical symbols together with the special symbols, notes and instructions shown on the drawings indicate the work and outlets required and are all to be included as a part of this specification.
- H. Coordination: This specification is accompanied by Drawings which contain floor plans of the buildings, sections and elevations, and site plans indicating locations of all outlets, switch controls, service runs, and other electrical apparatus. These locations are approximate and, before installing, the Contractor shall study the adjacent architectural details and actually make the

installation in the most logical manner. Any outlet, equipment, feeder, and circuit may be relocated within ten feet before installation at the direction of the DOD. The circuit routing is typical only and may be varied in any logical manner.

3.02 INSTALLATION

A. Grounding:

1. All services, metallic enclosures, raceways, and electrical equipment shall be grounded according to requirements of NEC Article 250. At building, 3/4" x 10' copper ground rods, Copperweld Steel Company, shall be driven with top 12" below finished grade and shall be connected together with bare copper wire buried 12" below finished grade to obtain a ground of 25 ohms or less as measured by three point pot method with an electric ground megger. Connect ground to nearest cold water pipe (located within 10' of entering the building), structural steel, and to building entrance equipment with bare copper. Ground and bond per the NEC and local authority having jurisdiction. Final connection to equipment, raceways, grounding type receptacles and other metallic parts directly exposed to ungrounded electric conductors shall be No. 8 AWG minimum, copper, NEC type TW, green insulation. Use approved bonding terminal at panels.
2. All grounding wire runs within building shall be routed together with circuit conductors.
3. Bond and ground all feeder conduits to panelboard enclosures.
4. Provide isolated ground wire from each isolated ground bus, in each panelboard, to the secondary neutral ground of the transformer serving the panelboard.

B. Wiring System:

1. Below grade use Schedule 40 PVC. Provide separate ground wire and rise out of ground with PVC and transition to medium walled epoxy resin coated fiberglass conduit within 6" of finished grade.
2. Above finished ground floor where exposed below 7'- 0" above finished floor use rigid steel conduit; in non-air conditioned locations use rigid steel conduit; exposed on the exterior of the building or beneath the building use rigid steel conduit; where exposed on exterior of the building and exposed to sunlight use regular walled sunlight-resistant epoxy resin coated fiberglass conduit with white finish and threaded fittings. Where exposed to corrosive atmospheres and near shorelines use regular walled sunlight-resistant epoxy resin coated fiberglass conduit. Where exposed to damage use rigid steel conduits or medium walled sunlight-resistant epoxy resin coated fiberglass conduits.
3. Above finished ground floor where concealed in walls or ceilings, and not exposed to damage, use EMT with compression fittings.

4. Where exposed on the roof, in damp, wet, or corrosive locations use sunlight-resistant epoxy resin coated fiberglass.
5. All wiring shall be installed in conduits except as noted.
6. Conduit system shall be continuous from outlet to outlet and fitting to fitting so that electrical continuity is obtained between all conduits of the system.
7. Conduits cut square and inner edges reamed. Butt together evenly within couplings.
8. Make bends and offsets with hickey or conduit-bending machine. Do not use vise or pipe tee. Flattened or crushed conduit not acceptable.
9. Use of running threads not permitted. Where conduits cannot be joined by standard threaded couplings, approved water-tight conduit unions shall be used.
10. Cap conduits during construction with plastic or metal-capped bushings to prevent entrance of dirt and moisture. Swab all conduits and dry before installing wires. Provide removable watertight conduit seals on all conduits entering the building, or pad mounted equipment, where the conduit is connected to manholes, handholes, light poles, or other pad mounted equipment.
11. Pullstrings shall be placed in all empty / spare conduits ten feet in length or longer.
12. Install insulating bushings and two locknuts on each end of every conduit run at enclosures and boxes. Provide grounding bushings as required.
13. Conduits shall not be installed in slabs. Route circuits feeding floor boxes in the ceiling space of the floor below.
14. Conduits passing through floor slabs and fire rated walls and ceilings shall be fire proofed.
15. Provide control conduit and wiring between the building management system and digital multi-function meters and programmable panelboards. Provide control conduit and wiring between all programmable panelboards.
16. Conduit bodies shall not be used on telecom conduits.

C. Conductors:

1. Mechanical means for pulling shall be torque-limiting type and not used for #2 AWG and smaller wires.
2. Pulling tension shall not exceed wire manufacturer's recommendations.

F. Miscellaneous Details:

1. Cut, drill and patch as required to install electrical system. Repair any surface damaged or marred by notching, drilling or any other process necessary for installation of electrical work. Cutting, repairs and refinishing subject to the approval of the DOD. Need for remedial work determined by the DOD as attributable to poor coordination and workmanship shall be cause for reconstruction to the satisfaction of the DOD and at no additional cost to the DOD.
2. Attachment of electrical equipment to wood by non-ferrous wood screws. Attachment to concrete by expansion anchors. Powder-charge-driven studs and anchors permitted only with prior approval.
3. Complete all panel circuit directories, using typewriter. Verify "room" and "use" designations before typing.
4. Prime and paint all exposed conduits, hangers, and fasteners.
5. All grounding wire within building run in rigid steel conduit.
6. Furnish necessary test equipment and make all tests necessary to check for unspecified grounding, shorts and wrong connections. Correct faulty conditions, if any.
7. Tag all empty conduits in switchboard, panelboards, cabinets, at backboards, etc. and identify destination.
8. Provide arc flash warning labels on all electrical equipment as required by 2014 NEC Article 110.16 and 2015 NFPA-70E 130.5. The contractor shall attain all information required for the calculations, perform the calculations, and provide the labels at no additional cost.
9. Anchor all free-standing floor mounted electrical equipment, apparatus, and transformers. Provide additional bracing per the seismic conditions at the site.

3.03 TESTING AND INSPECTION

- A. If the DOD (or its representative) discovers any errors, the Contractor, at his own expense, shall go over all similar portions of the entire job, taking the necessary or directed remedial action.
- B. Interior installations, 600 volts and less shall be tested for insulation resistance after all wiring is completed and ready for connection to fixtures and equipment. Using a 500V megger, measure and record the insulation resistance from phase to phase and phase to neutral. The records shall be submitted to the DOD for review and approval.
- C. The Contractor shall re-tape splices which have been bared for inspection. The Contractor shall test all portions of the electrical system furnished by him

for proper operation and freedom from accidental grounds. All tests shall be subject to the approval of the DOD.

- D. Wherever test or inspection reveals faulty equipment or installation, the Contractor shall take corrective action, at his own expense, repairing or replacing equipment or installation as directed.
- E. The Contractor shall de-energize, test (to verify de-energization), open, remove, and replace switchboard and panelboard covers for pre-final and final inspections by the DOD.

END OF SECTION

DIVISION 16 - ELECTRICAL

SECTION 16000 - GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. As specified in Section 01001.
- B. Electrical Work: Provide all articles, materials, equipment operators, systems and services specified herein and, on the Drawings, and as normally required by accepted industry standard practices, including all labor taxes, fees, insurance, warranties and incidentals required to complete all electrical work.
- C. In general, the following work is included:
 - 1. Demolish existing electrical connections and equipment as indicated on the drawings.
 - 2. Provide, complete and in place, electrical systems as indicated in the Drawings and specified herein. Provide, complete and in place, exterior electrical and lighting systems.
 - 3. Provide saw cutting (where required), excavation, shoring, bracing, suitable backfill material, concrete encasement, backfilling, compacting, ac patching (where required) and concrete patching (where required) for complete duct system installation.
 - 4. Coordinate work with Hawaiian Electric Company, Hawaiian Telcom, the State of Hawaii, and the City and County of Honolulu electrical inspectors.
 - 5. Electrical systems shall include full cutoff exterior light fixtures, energy efficient lights, automated lighting system with occupancy sensors, and photovoltaic renewable energy systems where required.
- D. Furnish required submittals and samples, operations and maintenance manuals, and "As-built" Drawings.
- E. Coordinate work with other trades to avoid omissions and overlapping of responsibilities.
- F. Apply for, obtain and pay for all County fees, permits, licenses, utility fees, assessments and inspections required for this work.
- G. Pay for all temporary construction and testing power.

- H. Provide the necessary power, temporary power, man-power, equipment, and information as necessary to perform the tests and to provide the necessary submittals.
- I. Before bidding, visit project site, carefully review each section of the Specifications and all Drawings of this Contract. Verify details, report any error, conflicts or omissions to the Department of Defense (DOD) at least 10 calendar days before submission of bids for interpretation or clarification. If errors or omissions are not reported, Contractor shall provide necessary work at no additional cost to the DOD to properly complete intent of Specifications and Drawings. By submitting a proposal of the work included in this contract, the Contractor shall be deemed to have made such examination and to be familiar with and accept all conditions of the job site.

1.02 SUMMARY

This Section includes specifications for exterior electrical work.

1.03 INTENT OF SPECIFICATIONS AND DRAWINGS

- A. Specifications and Drawings are prepared in abbreviated form and include incomplete sentences. Omission of words or phrases such as “the Contractor shall”, “as shown on the drawings”, “a” and “the” are intentional. Omitted words and phrases shall be provided by inference to form complete sentences.
- B. Specifications and Drawings complement each other and what is specified, scheduled or mentioned on one shall be binding as if called for by both.
- C. Discrepancies and Interpretations:
 - 1. 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 DOD who will issue any necessary clarification within a time period which does not disrupt the progress of the work.
 - 2. All interpretation and supplemental instructions will be in the form of a written addendum to the Contract Documents.
 - 3. Should any discrepancies arise from the failure of the Contractor to notify the DOD, the higher quality or larger quantity of item shall prevail. The DOD shall make the final interpretation and judgment.
 - 4. In the event of a discrepancy between small scale drawings and large scale details, or between Drawings and Specifications, of 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 DOD 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.

1.04 DEFINITIONS

- A. Provide: "Furnish and install, test and deliver to the DOD in operating and ready to use condition."
- B. Wiring: "Provide all raceways, junction boxes, conductors, devices, protection equipment, installation of motor controllers (furnished by others) when required, etc., including testing for a complete, operative and ready to use electrical system."
- C. Equal: "Material, equipment or system, including all necessary labor, modifications and accessories satisfying the requirements of the contract documents, the design intent, and to provide features or have operating characteristics equal or better than that specified."
- D. Complete: "Furnish installation that is operative, tested, and ready to use and which satisfies the intent of the contract documents, including all necessary accessories and modifications."
- E. Contractor: "General Contractor responsible for all work shall assign work to Sub-Contractors. Except where noted, work of this section shall be assigned to the Electrical Sub-Contractor."
- F. HECO: Hawaiian Electric Company
- G. HTCO: Hawaiian Telcom
- H. Oceanic: Oceanic Time Warner Cable

1.05 QUALITY ASSURANCE

- A. Government and Utility Requirements: Comply with all requirements of the State of Hawaii, City and County of Honolulu, Disability and Communication Access Board (DCAB), and respective utility company rules and regulations.
- B. Specifications are accompanied by architectural, civil, mechanical, landscape, and audio-visual plans of the buildings, site, and diagrammatical electrical plans showing locations of luminaries, standards, outlets, feeder runs, devices and other electrical equipment. Locations are approximate and before installation, Contractor shall study adjacent construction details and make installation in the most logical manner. Prior to installation and at the direction of the DOD, relocate any device, equipment, feeder, or circuit within 10'-0" of the location presently shown without added cost to the DOD.
- C. Prior to start of the rough-in work, verify all dimensions and equipment sizes with the approved shop drawings including equipment furnished by others. Circuits and raceway routes are diagrammatic and may be altered in any logical manner. However, all changes from the contract documents shall be subject to review and acceptance of the DOD and indicated on the "As-built" Drawings.

- D. Feeders and branch circuits for equipment furnished by others were sized for the anticipate equipment. Verify electrical requirements of all equipment furnished by others prior to rough in and prior to ordering of the electrical distribution equipment. Re-size affected feeders and branch circuits at no additional cost to the DOD.
- E. Materials and Equipment: Materials and equipment shall conform to requirements of applicable technical specification sections, publications specified therein and shall be as shown on the drawings. Materials and equipment shall be new and shall be the product of manufacturers regularly engaged in the manufacture of such products.

All items shall essentially duplicate materials and equipment which have been in satisfactory use at least two years prior to bid opening and shall be supported by a service organization that is located reasonably close to the site of installation.

F. Substitutions:

1. Where items are specified by manufacturer's name or catalog number, substitutions require written permission by the DOD prior to bidding. Brand names, manufacturer's names and catalog numbers indicate the standard of design and quality required. List of substitute materials together with qualifying data shall be submitted for review at least twelve (12) working days before bid date. Failure to submit for review substitute materials prior to bidding shall mean that materials, as specified, will be provided. Substitute materials submitted and rejected shall not be resubmitted in any modified form.
2. Samples of proposed substitute items may be required and shall be submitted by the Contractor at his expense as soon as practicable after they are requested.
3. Burden of proof of equality of proposed substitutions will be the responsibility of the Contractor. Submittals shall be sufficiently detailed to permit evaluation of the proposed items. Inadequacy of submittals shall be sufficient cause to reject a proposed substitution.
4. All prospective bidders must submit descriptive information on proposed material for pre-bidding acceptance where an item is detailed but no manufacturer is named.
5. Costs to review any contractor submitted value engineering change proposals shall be paid by the Contractor.

- G. Prevention of Corrosion: All metallic materials shall be protected against corrosion. Exposed metallic parts of equipment, apparatus, devices, mounting hardware, and fasteners that are provided in damp, wet, or corrosive areas shall be constructed from 316 or 316L stainless steel. All such parts as boxes, bodies, fittings, guards and miscellaneous parts shall be constructed of 316 or 316L stainless steel. The Contractor shall not join dissimilar metals that will result in deterioration due to galvanic corrosion.

1.06 DEPARTURES

- A. Departures resulting from the substitution of materials or systems shall be accompanied by appropriate changes in all affected work of every trade and shall include stamped and signed drawings by a licensed engineer for any portion of the project requiring re-design. Such changes shall be done at no increase to the contract amount and shall be the responsibility of the Sub-Contractor or supplier responsible for the departures. Changes proposed by the Contractor shall be based on a system approach and may be allowed if implemented without decrease in quality, performance and operations, increase in utility costs or adverse effect on the available physical space to install the equipment. Such departures shall be submitted and noted in shop drawings for review and acceptance by the DOD. Departures initiated by other trades, requiring changes in the electrical system as well as other systems, shall be accompanied by appropriate changes to all affected work of every trade, at no increase in contract amount. Submission for departure shall be as follows:

EXAMPLE:

<u>Item</u>	<u>Manufacturer and Catalog Number Specified</u>	<u>Substitute Manufacturer and Catalog Number</u>
Cable	John Doe - No. 3200	King - No. 2200

- B. The General Contractor shall be responsible to coordinate, approve and select systems that do not impose unaccounted for impacts on the electrical work. It shall be understood that after the award of contract, all departures having electrical impact, unless otherwise noted, have been reviewed and approved by the General Contractor.

1.07 SUBMITTALS

- A. Submit in accordance with Section 01300 - SUBMITTALS. All submittals shall be reviewed and approved by the general contractor and the electrical contractor. Partial submittals or submittals lacking the general contractor's and electrical contractor's approvals will not be acceptable. Submit for approval six (6) complete sets of submittals as described below. Annotate descriptive data to show the specific model, type, option, and size of each item the Contractor proposes to furnish. Do not commence work until each system, including all the various components, have been approved. The DOD will review and approve all submittals. Before the materials are ordered or the work is commenced the shop drawings must be approved. All submittals shall be submitted to and reviewed by the LEED Administrator as necessary for the LEED documentation process.
- B. List of Materials and Equipment: Submit in accordance with Section 01330 - SUBMITTALS. These lists shall include manufacturer's names and material or equipment identification such as styles, types, or catalog numbers to permit ready and complete identification. Original catalog cuts or brochures shall be provided. Scanned or photocopied submittals will be rejected without review.

- C. Product Data: Shall be sufficiently comprehensive and detailed to permit evaluations, otherwise the item may be rejected, and shall include, as applicable, the following:
1. Original catalog cuts or brochures shall be provided. Scanned or photocopied submittals will be rejected without review.
 2. Each submittal shall contain an itemized list of each item being submitted. Each item shall be identified with the complete manufacturer's ordering number including all options.
 3. Dimension outlines of all enclosures.
 4. Dimension drawings of components such as switchboard, motor control center, panelboards, transformers, enclosed circuit breakers, safety disconnect switches, inverters, and generators.
 5. Scaled drawings showing the layouts and arrangement of equipment in all electrical rooms, telecom rooms, and generator rooms.
 6. Operating and electrical characteristics including interrupting ratings and impedances.
- D. Certificate of Compliance: Where required by the section specifying the equipment, the Contractor shall submit six (6) copies of certificates of compliance in accordance with the requirements of the GENERAL REQUIREMENTS. The certificates shall include but not be limited to factory test reports.
- E. Installation, Operation and Maintenance Data: Six (6) copies of installation, operation and maintenance data shall be submitted for equipment specified to require such data. The data shall be in the form of manuals and shall indicate instructions for operating, maintaining, repairing, recommended inspection points, periods for inspection, and all related spare parts in a practical, complete and comprehensive manner. The information shall be arranged in a logical, orderly sequence, including a general description of the equipment and significant technical characteristics.
- Test, adjustment and calibration information shall be furnished and identified to specific equipment. The installation, operation and maintenance data shall be as required by the General Requirements.
- F. Acceptance Requirements: Acceptance for material and equipment will be based on manufacturer's published data. Where materials or equipment are specified to be constructed and tested, or both, in accordance with the standards of the National Electrical Manufacturers Association (NEMA) or the American National Standards Institute (ANSI), the Contractor shall submit proof that the items furnished under this section of the specifications conform to such requirements. A certification or published catalog specification data statement to the effect that the item is in accordance with the referenced NEMA standard by a company listed as a member company of NEMA for the section whose standards cover the item under

construction, will be acceptable as sufficient evidence that the item conforms to the requirements of the National Electrical Manufacturers Association. A manufacturer's statement indicating complete compliance of each item with the applicable NEMA, ANSI or other commercial standard specified shall be submitted and will be acceptable proof of compliance. Conformance with the agency requirements does not relieve the item from complying with any other requirements of the specifications.

G. Nameplates:

1. General: In addition to standard manufacturer's nameplate, permanent corrosion resistant nameplates shall be provided for each enclosed circuit breaker, safety switch, panelboard, lighting contactor, inverter, telecom junction box, and other major pieces of equipment. Nameplates shall designate the function of the equipment for which they are used. The designation shall be submitted for review and acceptance with the shop drawings.
2. Material and Lettering: 1/16" thick, laminated plastic, black-white-black. Nameplate lettering shall be 1/4" high upper-case.
3. Fastening: Nameplates shall be fastened stainless steel (316) screws.
4. Hand lettering or stick-on embossed marking tape is not acceptable.
5. Provide laminated tape labeling for all new receptacles on coverplates. Identify associated panel name and circuit number.

H. Labels

1. Provide labels as required by the latest version of the National Electrical Code adopted by the County or City & County.
2. The labels shall be designed according to the following standards:
 - a. UL969 – Standard for Marking and Labeling Systems.
 - b. ANSI Z535.4 – Product Safety Signs and Labels.
 - c. NFPA 70 (National Electric Code) – Article 110.16.
 - d. NFPA 70E – Section 130.
3. Labels shall be provided for, but not limited to:
 - a. Available fault currents at the service equipment per 2014 NEC 110.24(A).
 - b. Arc Flash warning labels shall be provided per 2014 NEC 110.16 and 2015 NFPA-70E 130.5. The contractor shall attain all information required for the calculations, perform the calculations, and provide the labels at no additional cost.

- c. Source and location of feeder serving switchboards and panelboards per NEC 408.4(B).
 - d. Method utilized for conductor identification per 2014 NEC 210.5(C).
 - e. All telecommunication, telephone, data, and signal cables.
- 4. Label materials shall be provided similar to nameplates except that labels for wires, conductors, and cables shall be of the printed tape type.
- I. Factory Tests and Inspection:
 - 1. The equipment furnished shall be inspected mechanically and electrically, and all manufacturers' routine factory tests shall be performed to verify conformance with the specified requirements. The test equipment and test methods shall conform to the requirements of standards specified. The contract price shall include cost of performing all tests.
 - 2. The Contractor shall furnish, at time of equipment delivery, six (6) certified copies of all test results.
- J. Equipment Guarantees: Installation shall be complete in every detail and ready for use. Any item furnished or provided by the Contractor developing defects within one (1) year after final acceptance by the DOD shall be replaced by materials, apparatus and parts including installation labor costs to make such defective portion of the completed system conform to the true intent and meaning of the drawings and specifications, without additional cost to the DOD. The Contractor shall guarantee all equipment provided from the date such equipment is accepted by the DOD, against defects in materials, design, performance and workmanship. Guarantees shall be supported by manufacturer's written warranties and shall be signed by an official of the manufacturer's organization. Replacement parts shall be delivered and repairs shall be made promptly upon receipt of notice of failure under normal and proper use and maintenance. All costs of replacement and repair shall be borne by the Contractor provided that a report substantiating such defect or failure to conform to specifications is promptly given to the Contractor.

1.08 CODES, REGULATIONS AND STANDARD SPECIFICATIONS

- A. Work shall conform to the Hawaii Revised Statutes, the Ordinances of City and County of Honolulu; the International Conference of Building Officials (ICBO) International Building Code (IBC); and the latest edition of National Electrical Code (NEC).
- B. Applicable rules, standards and specifications of following associations shall apply to materials, workmanship, and procedures:

American National Standards Institute (ANSI)

Illuminating Engineering Society of North America (IESNA)
National Electrical Manufacturer's Association (NEMA)
National Fire Protection Association (NFPA)
Underwriters' Laboratories, Inc. (UL)

1.09 ACKNOWLEDGEMENT

- A. By bidding on this project and or by providing this work the Contractor acknowledges that:
1. The Designer is not responsible for the means and methods employed by the Contractor and that the Contractor is responsible for his means and methods.
 2. The Designer is not responsible for job site and worker safety and that the Contractor is responsible for job site and worker safety.

1.10 WARRANTY

- A. Defective materials and workmanship shall be removed and replaced at no cost to the DOD. For period of one year after acceptance of work by DOD, materials and workmanship developing defects and malfunctions shall be repaired and/or replaced, to conform with intent of the specification and drawings, at no additional cost to the DOD.

PART 2 - PRODUCTS

2.01 MATERIALS

All materials shall be new, except as specifically noted, and shall bear the label of Underwriter's Laboratories, Inc., wherever standards have been established and label service is normally and regularly furnished by the agency. See the respective technical sections for the electrical material specifications.

PART 3 - EXECUTION

3.01 MATERIALS AND EQUIPMENT PROVIDED BY THE CONTRACTOR

The electrical installation shall be complete and operable and shall conform to the requirements of the contract drawings. The Contractor shall provide all electrical equipment and materials, wiring, supports and such additional parts as are necessary to make the installation complete. All Contractor furnished materials and equipment are subject to review and acceptance by the DOD.

3.02 PROTECTION DURING STORAGE

Store all materials and equipment in a safe manner. Provide weather, dehumidification, and fire protection for all materials. Store all materials above grade to avoid damage by moisture. Cover all materials to avoid damage from sunlight.

3.03 PROTECTION OF WORK IN PROGRESS

All electrical materials and equipment shall be completely protected during installation. Equipment shall be securely protected against physical or chemical damage. In areas exposed to weather, materials unused at the end of each day's work shall be protected by weatherproofed installations. All unprotected conduits shall be sealed to prevent water and foreign debris from entering conduits. Damage to materials and equipment due to Contractor's neglect shall be repaired or replaced by and at the expense of the Contractor.

3.04 PROGRESS OF WORK AND COORDINATION

The Contractor shall prepare a schedule identifying the sequence of electrical work. The electrical work shall be coordinated with the work of other Contractors and other trades. The schedule shall be submitted prior to beginning installation and shall be subject to review and acceptance by the DOD.

3.05 RULES

The entire electrical installation shall conform to the applicable rules and regulations of the State Fire Code and the standards and publications specified in the technical sections.

3.06 COORDINATION

The contract drawings indicate the extent and general location and arrangement of equipment, conduit and wiring. Lighting fixtures, outlets and electrical equipment shall be located so as to avoid interference with architectural, mechanical and structural features. The DOD may request any device, equipment, circuit, or feeder to be relocated within 10'-0" of the location shown on the Drawings before installation is initiated and without increase in contract amount.

3.07 WORKMANSHIP

- A. All materials and equipment shall be installed in accordance with printed recommendations of the manufacturer and shall conform to the requirements of the contract drawings. The installation shall be accomplished by workers skilled in this type of work. For actual fabrication, installation and testing of the Electrical Work, use only thoroughly trained and experienced workmen completely familiar with items to be installed and with manufacturers' recommended methods of installation. In acceptance or rejection of installed work no allowance will be made for lack of skill on part of workmen.
- B. Inspection: Skill and competency of workmanship shall be subject to the approval of the State, and the City and County of Honolulu. The contractor shall open all electrical equipment, cabinets, junction boxes, and devices as required by the City and County of Honolulu or inspector for inspection. All equipment shall be de-energized prior to inspection unless voltage and current measurements are required. The Contractor shall be responsible for all electrical and arc flash safety at the project site.

3.08 FIELD TESTS

- A. After the installation is completed, and at such time the DOD may direct, the Contractor shall conduct field tests for acceptance by the DOD. When the tests are specified to be performed under the supervision of the equipment manufacturer, the Contractor shall cooperate with the DOD during tests and shall place at the manufacturer's disposal, all assistance, materials and services required to perform such tests. The tests shall be performed in the presence and to the satisfaction of the DOD. The Contractor shall furnish all necessary electric power, fuel, instruments, equipment, and personnel required for the tests and shall pay for all power and fuel.
- B. Insulation Tests: The insulation of all conductors shall be tested with a megger insulation tester. Submit results of tests to the DOD.
- C. Operating Tests: The equipment and systems shall be demonstrated to operate in accordance with the requirements of the technical sections in which the equipment or systems are specified.
- D. Ground Resistance Test: Test ground resistance by three-point method. Results of test shall be submitted to the DOD. Ground Resistance: Ground resistance measurements of each ground rod shall be taken and certified by the Contractor. Upon completion of the project, the Contractor shall submit in writing to the DOD, the measured ground resistance of each ground rod and grounding system, as well as the resistance and soil conditions at the time the measurements were made. Ground resistance measurements shall be made in normally dry weather, not less than 48 hours after rainfall, and with the ground under test isolated from other grounds.
- E. Test all 600 volt class conductors to verify that no short circuits or accidental grounds exist. Make tests using an instrument which applies a voltage of approximately 500 volts to provide a direct reading in resistance, and measure the insulation resistance from phase to phase and phase to neutral. All test results shall be recorded and submitted to the DOD.
- F. Wherever test or inspection reveals faulty materials or installation, Contractor shall take corrective action, at his own expense, repairing or replacing materials or installation as directed. The materials or installation shall then be retested.

END OF SECTION

SECTION 16050 – ELECTRICAL BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

As specified in Section 01001.

1.02 SUMMARY

- A. This section provides the specifications for general electrical work. See other specification sections for more detailed specifications related to specific electrical systems.
- B. The Contractor shall furnish all labor, materials, tools, equipment, electricity, fuel, shipping and delivery, and appliances required to provide all Electrical Work, complete, as indicated on the drawings and/or as specified herein. The drawings note various sizes of equipment as determined for basis of design; the electrical work, however, shall be installed to comply with the equipment furnished by the successful supplier and shall be based on the approved shop drawing submittals. The work shall include but not necessarily be limited to, the following:
 - C. Complete power distribution system.
 - D. Complete general use and special power systems.
 - E. Connection and testing of appliances and equipment furnished by others requiring electrical connections.
 - F. Before bidding on this work, carefully examine each of the drawings and the site. By submitting a proposal of the work included in this contract, the Contractor shall be deemed to have made such examination and to be familiar with and accept all conditions of the job site.

1.03 SUBMITTALS

- A. Submit in accordance with Section 01300 - SUBMITTALS.
- B. Shop drawings and catalogue 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 catalogue cuts shall not release Contractor from complying with intent of specification and drawings. Partial or incomplete submittals will be returned without review.

- C. Shop Drawings: Submit complete shop drawings and manufacturer's literature for the Department of Defense's (DOD) review before any work is ordered or fabricated. All submittals shall have the approval of the general contractor and the electrical contractor. Partial or incomplete submittals or submittals lacking the general contractor's and electrical contractor's approval will be returned without review. Submit in accordance with Section 01300 - SUBMITTALS. Submit manufacturer's literature for the following:
 - 1. Conductors
 - 2. Raceways
- D. As-Built Drawings: Submit as-built drawings as specified under Section 01700 - CONTRACT CLOSEOUT.

1.04 GUARANTEE AND CERTIFICATES

- A. Any item of material, apparatus, equipment furnished and installed, or constructed by the Contractor showing defects in design, construction, quality or workmanship within one year from the date of final acceptance by the DOD shall be replaced by such new material, apparatus or parts as may be found necessary to make such defective portion of the installation conform to the true intent and meaning of the specification and/or the drawings. Exceptions shall be fluorescent and incandescent lamps which shall be guaranteed for one half the manufacturer's listed life time. Such repairs or replacement shall be made by the Contractor, free of all expense to the DOD.

1.05 COORDINATION WITH UTILITY COMPANIES AND OTHER TRADES

During bidding and construction, Contractor shall coordinate his work with utilities, and other trades to avoid omissions and overlapping of responsibilities.

1.06 CODES, REGULATIONS AND STANDARD SPECIFICATIONS

- A. Work shall conform to latest edition of National Electrical Code.
- B. Applicable rules, standards and specifications of following associations shall apply to materials and workmanship:

- American National Standards Institute (ANSI)
- Illuminating Engineering Society of North America (IESNA)
- National Board of Fire Underwriters (NBFU)
- National Electrical Manufacturer's Association (NEMA)
- National Fire Protection Association (NFPA)
- Underwriters' Laboratories, Inc. (UL)

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General: All materials shall be new, except as specifically noted, and shall bear the label of Underwriters' Laboratories whenever standards have been

established and label service is normally and regularly furnished by the agency.

B. Raceways:

1. Conduits: EMT and galvanized rigid steel, 3/4" minimum diameter with compression or threaded fittings, respectively. Aluminum conduits shall not be used.
2. Non-Metallic Conduit: PVC Schedule 40 and sunlight-resistant epoxy resin coated fiberglass, wall thickness as indicated (ISO 9001: 2008 certified), 3/4" minimum diameter.
3. Reinforced Thermosetting Resin Conduit: NEMA Standard TC 14, UL 2515 IPS above Ground and 2515A Extra Heavy Wall standards, ISO 9001: 2015 Quality Control Management, Type AG, sunlight resistant, wall thickness as required to provide degree of protection suitable for installation location.
4. Flexible Conduit: 3/4" minimum, zinc-coated inside and outside; for damp, wet, moist, or corrosive areas -- liquid-tight with factory fittings and UV stabilized PVC jacket.

- C. Conductors: Conductors shall be copper, No. 12 AWG minimum; No. 10 AWG and smaller, solid and round; No. 8 AWG and larger, 7 or 19 strands concentric. All conductors No. 6 and smaller shall be types THW for interior use or RHW for exterior use. All conductors No. 4 AWG and larger shall be type THWN-2 for interior use; or RHW-2 or USE-2 for exterior use. Conductors used for fire alarm, sound system, and control wiring may be sized according to the system manufacturer based on their load and voltage drop calculations and code requirements. Conductors used to serve critical operations power systems (power systems for facilities or parts of facilities that require continuous operations for reasons of public safety, emergency management, national security, or business continuity) including but not limited to emergency power, HVAC, fire alarm, security, telecommunications, and signaling shall be a listed 2-hour electrical circuit protective system. Conductors installed on roof tops and exposed to sunlight shall be derated per NEC Table 310.15(B)(2)(b) or shall be type XHHW-2. Conduit sizes shall be increased as necessary to accommodate derated and type XHHW-2 conductors. Reduce conductor sizes at equipment terminations as required to accommodate maximum allowable conductor size accepted at equipment terminals per manufacturer's recommendations. Provide UL listed in-line reducer splice kit or UL listed cable reducing adapter plugs as required to reduce conductor sizes.

D. Device and Cover Plates:

1. Plates for interior flush construction shall be smooth reinforced plastic, with suitable hole(s) and color to match device. Plates for receptacles on Department of Education projects shall be brushed stainless steel.

2. Device covers outlets in damp, wet, or corrosive locations shall be weatherproof with lockable stainless steel (316) covers. Covers shall permit plugs to be connected without compromising the integrity of the protective nature of the cover while in use.
 3. Light switch plates for areas exposed to the elements, damp, or wet installations shall be neoprene gasketed cast aluminum, gray powder coat finish, with spring loaded neoprene gasketed flip-open lids.
 4. Plates for receptacles on emergency circuits shall be red.
 5. Plates for receptacles serving telecommunication loads on Department of Education projects shall be blue.
 6. Plates for receptacles shall be labeled with the name of the panelboard and circuit number serving the receptacle.
- E. Duct Sealant: Shall not affect physical or electrical properties of wire and cable. Shall meet NEC codes for raceway seals and be UL listed. Shall be capable of holding 15 feet waterhead pressure continuous and block up to 4 psi gas or vapor continuous. Polywater FST, or pre-approved substitute.
- F. Hardware, Supports, Backing, Etc.: All hardware, fasteners, supports, backing and other accessories necessary to install electrical equipment shall be provided. Wood materials shall be "wolmanized" treated against termites, iron or steel materials shall be galvanized for corrosion protection, and non-ferrous materials shall be brass or bronze. Installations in damp, wet, or corrosive locations shall be of stainless steel, 316.

PART 3 - EXECUTION

3.01 GENERAL

- A. Rules and Permit: The entire installation shall be made in strict accordance with the latest rules and regulations of the National Board of Fire Underwriters, the currently adopted edition of the National Electrical Code and the Electrical Branch of the local Building Department. The Contractor shall obtain and pay for the electrical permit as required by local laws and rules. All work shall be inspected by the proper local authorities as it progresses. The Contractor shall pay all inspection fees and shall deliver certificates of completion and inspection to the City and County of Honolulu before final payment will be made. Costs of permits and inspection fees shall be included in the Contractor's bid price.
- B. Construction Methods: Construction shall conform to construction practices as recommended by the American Electricians Handbook by Croft (latest edition), Edison Electric Institute, National Electrical Code, National fire Protection Association, National Electrical Safety Code and applicable instructions of manufacturers of equipment and material supplied for this project.
- C. Materials and Workmanship: All labor and materials of every kind shall be subject to the approval of the DOD, who shall be afforded every facility for

ascertaining the competence of such labor and examining such materials as they may deem necessary. Concealed work, handholes, and enclosures shall be reopened / opened at random as directed during inspections by the DOD. Materials shall be new and shall bear the listed label of the Underwriters' Laboratories, Inc. Brand names and catalog numbers used in this specification indicate the standards of design and quality required. Substitution of other brands or catalog numbers shall conform to the requirements in the Bidding Documents. All high voltage work shall be performed by qualified electricians certified to work on high voltage systems.

- D. Record Drawings: The Contractor shall maintain an accurate and adequate record of each change as it occurs, regardless of how ordered.
- E. Drawings and Specification: This specification is intended to cover all labor, materials and standards of workmanship to be employed in the work indicated on the Drawings and called for in the specification or reasonably implied therein. The Drawings and specification supplement one another. Any part of the work mentioned in one and not represented in the other, shall be done the same as if it has been mentioned in both. The Contractor shall not make alterations in the Drawings and specification.
- F. Discrepancies and Interpretations:
 - 1. 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 DOD who will issue any necessary clarification within a time period which does not disrupt the progress of the work.
 - 2. All interpretation and supplemental instructions will be in the form of a written addenda to the Contract Documents.
 - 3. Should any discrepancy arise from the failure of the Contractor to notify the DOD, the higher quality or larger quantity of item shall prevail. The DOD shall make the final interpretation and judgment.
 - 4. In the event of a discrepancy between small scale drawings and large scale details, or between the 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 DOD 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.
- G. Symbols: The standard electrical symbols together with the special symbols, notes and instructions shown on the drawings indicate the work and outlets required and are all to be included as a part of this specification.
- H. Coordination: This specification is accompanied by Drawings which contain floor plans of the buildings, sections and elevations, and site plans indicating locations of all outlets, switch controls, service runs, and other electrical apparatus. These locations are approximate and, before installing, the Contractor shall study the adjacent architectural details and actually make the

installation in the most logical manner. Any outlet, equipment, feeder, and circuit may be relocated within ten feet before installation at the direction of the DOD. The circuit routing is typical only and may be varied in any logical manner.

3.02 INSTALLATION

A. Grounding:

1. All services, metallic enclosures, raceways, and electrical equipment shall be grounded according to requirements of NEC Article 250. At building, 3/4" x 10' copper ground rods, Copperweld Steel Company, shall be driven with top 12" below finished grade and shall be connected together with bare copper wire buried 12" below finished grade to obtain a ground of 25 ohms or less as measured by three point pot method with an electric ground megger. Connect ground to nearest cold water pipe (located within 10' of entering the building), structural steel, and to building entrance equipment with bare copper. Ground and bond per the NEC and local authority having jurisdiction. Final connection to equipment, raceways, grounding type receptacles and other metallic parts directly exposed to ungrounded electric conductors shall be No. 8 AWG minimum, copper, NEC type TW, green insulation. Use approved bonding terminal at panels.
2. All grounding wire runs within building shall be routed together with circuit conductors.
3. Bond and ground all feeder conduits to panelboard enclosures.
4. Provide isolated ground wire from each isolated ground bus, in each panelboard, to the secondary neutral ground of the transformer serving the panelboard.

B. Wiring System:

1. Below grade use Schedule 40 PVC. Provide separate ground wire and rise out of ground with PVC and transition to medium walled epoxy resin coated fiberglass conduit within 6" of finished grade.
2. Above finished ground floor where exposed below 7'- 0" above finished floor use rigid steel conduit; in non-air conditioned locations use rigid steel conduit; exposed on the exterior of the building or beneath the building use rigid steel conduit; where exposed on exterior of the building and exposed to sunlight use regular walled sunlight-resistant epoxy resin coated fiberglass conduit with white finish and threaded fittings. Where exposed to corrosive atmospheres and near shorelines use regular walled sunlight-resistant epoxy resin coated fiberglass conduit. Where exposed to damage use rigid steel conduits or medium walled sunlight-resistant epoxy resin coated fiberglass conduits.
3. Above finished ground floor where concealed in walls or ceilings, and not exposed to damage, use EMT with compression fittings.

4. Where exposed on the roof, in damp, wet, or corrosive locations use sunlight-resistant epoxy resin coated fiberglass.
5. All wiring shall be installed in conduits except as noted.
6. Conduit system shall be continuous from outlet to outlet and fitting to fitting so that electrical continuity is obtained between all conduits of the system.
7. Conduits cut square and inner edges reamed. Butt together evenly within couplings.
8. Make bends and offsets with hickey or conduit-bending machine. Do not use vise or pipe tee. Flattened or crushed conduit not acceptable.
9. Use of running threads not permitted. Where conduits cannot be joined by standard threaded couplings, approved water-tight conduit unions shall be used.
10. Cap conduits during construction with plastic or metal-capped bushings to prevent entrance of dirt and moisture. Swab all conduits and dry before installing wires. Provide removable watertight conduit seals on all conduits entering the building, or pad mounted equipment, where the conduit is connected to manholes, handholes, light poles, or other pad mounted equipment.
11. Pullstrings shall be placed in all empty / spare conduits ten feet in length or longer.
12. Install insulating bushings and two locknuts on each end of every conduit run at enclosures and boxes. Provide grounding bushings as required.
13. Conduits shall not be installed in slabs. Route circuits feeding floor boxes in the ceiling space of the floor below.
14. Conduits passing through floor slabs and fire rated walls and ceilings shall be fire proofed.
15. Provide control conduit and wiring between the building management system and digital multi-function meters and programmable panelboards. Provide control conduit and wiring between all programmable panelboards.
16. Conduit bodies shall not be used on telecom conduits.

C. Conductors:

1. Mechanical means for pulling shall be torque-limiting type and not used for #2 AWG and smaller wires.
2. Pulling tension shall not exceed wire manufacturer's recommendations.

F. Miscellaneous Details:

1. Cut, drill and patch as required to install electrical system. Repair any surface damaged or marred by notching, drilling or any other process necessary for installation of electrical work. Cutting, repairs and refinishing subject to the approval of the DOD. Need for remedial work determined by the DOD as attributable to poor coordination and workmanship shall be cause for reconstruction to the satisfaction of the DOD and at no additional cost to the DOD.
2. Attachment of electrical equipment to wood by non-ferrous wood screws. Attachment to concrete by expansion anchors. Powder-charge-driven studs and anchors permitted only with prior approval.
3. Complete all panel circuit directories, using typewriter. Verify "room" and "use" designations before typing.
4. Prime and paint all exposed conduits, hangers, and fasteners.
5. All grounding wire within building run in rigid steel conduit.
6. Furnish necessary test equipment and make all tests necessary to check for unspecified grounding, shorts and wrong connections. Correct faulty conditions, if any.
7. Tag all empty conduits in switchboard, panelboards, cabinets, at backboards, etc. and identify destination.
8. Provide arc flash warning labels on all electrical equipment as required by 2014 NEC Article 110.16 and 2015 NFPA-70E 130.5. The contractor shall attain all information required for the calculations, perform the calculations, and provide the labels at no additional cost.
9. Anchor all free-standing floor mounted electrical equipment, apparatus, and transformers. Provide additional bracing per the seismic conditions at the site.

3.03 TESTING AND INSPECTION

- A. If the DOD (or its representative) discovers any errors, the Contractor, at his own expense, shall go over all similar portions of the entire job, taking the necessary or directed remedial action.
- B. Interior installations, 600 volts and less shall be tested for insulation resistance after all wiring is completed and ready for connection to fixtures and equipment. Using a 500V megger, measure and record the insulation resistance from phase to phase and phase to neutral. The records shall be submitted to the DOD for review and approval.
- C. The Contractor shall re-tape splices which have been bared for inspection. The Contractor shall test all portions of the electrical system furnished by him

for proper operation and freedom from accidental grounds. All tests shall be subject to the approval of the DOD.

- D. Wherever test or inspection reveals faulty equipment or installation, the Contractor shall take corrective action, at his own expense, repairing or replacing equipment or installation as directed.
- E. The Contractor shall de-energize, test (to verify de-energization), open, remove, and replace switchboard and panelboard covers for pre-final and final inspections by the DOD.

END OF SECTION

SECTION 16301- UNDERGROUND ELECTRICAL WORK

PART 1 - GENERAL

1.01 GENERAL CONDITIONS

- A. As specified in Section 16000 – GENERAL ELECTRICAL REQUIREMENTS.

1.02 DESCRIPTION OF WORK

- A. In general, provide complete underground secondary distribution systems within project boundaries and as indicated in the drawings.
- B. Provide all material, labor, tools and equipment to construct all items as indicated on the drawings and as specified herein, including but not limited to the following:
 - 1. Complete underground distribution system including trenches, concrete ducts, and handholes.
 - 2. Saw-cut and patch existing concrete sidewalks or AC pavement to match existing. Repaint any painted patterns (hop-sotch, etc.) which may be damaged. Match existing patterns and colors.
 - 3. Remove and replace tables, benches, trees, bushes and landscaping as necessary for trenching work. Maintain plants at temporary location on site and re-plant as soon as ductline work is completed. Relocate and reinstall tables, benches, trees, and bushes within 50' at no additional cost to the Department of Defense (DOD).
 - 4. Pass test mandrel through **all** ducts and conduits 2" and larger, and make corrections as directed by inspectors or Engineer. Mandrel test requirements shall be as specified in the latest edition of Hawaiian Telcom's mandrel testing requirements. Corrections made shall be at no additional cost to the DOD.
 - 5. Provide polypropylene pullstring in all empty ducts and conduits, unless indicated otherwise.
 - 6. All structures and ductlines being provided to support Hawaiian Electric Company (HECO) shall be provided in accordance with HECO's standards.
 - 7. Immediately report and pay for damages to existing equipment and facilities.
- C. Obtain and pay for electrical permits, arrange for periodic inspection by local authorities and deliver certificate of final inspection to Engineer.
- D. Contractor shall check and test the installation for completeness and functional operation as described by the drawings and specified herein. Final test shall be in the presence of Engineer. Contractor shall arrange and pay for all testing costs.
- E. Should intermediate or final inspections of the duct system reveal crushed, damaged, or impassable ducts, the Contractor shall repair those sections of duct

system, including repairs to paved surfaces, concrete structures, and landscaping, at no additional cost to the DOD.

1.03 SCHEDULING OF WORK

Schedule all trenching with the DOD. Obtain approvals for all trenching work.

1.04 COORDINATION WITH THE UTILITIES AND OTHER TRADES

During pricing and construction, Contractor shall coordinate his work with the other trades to avoid omissions and overlapping of responsibilities. Obtain and review the standards and specifications of the local utility companies.

1.05 DRAWINGS

- A. Before installation, verify all dimensions, conditions and sizes of equipment at job site.
- B. Verify details, report all conflicts and omissions to Engineer.
- C. Work shall be in accordance with the drawings and specifications. Exceptions, changes and deviations from the work intended may be made only with the approval of Engineer. Submissions for approval shall consist of drawings, written explanation and reason for request; six (6) copies. Changes and additions shall be recorded daily on copy of contract specifications and drawings, which shall be maintained at job site.

1.06 SUBMITTALS

- A. General: Submit under provisions of Section 01330 – SUBMITTAL PROCEDURES.
- B. Shop Drawings: Submit complete shop drawings and manufacturer's literature for the Engineer's review before any work is ordered or fabricated. Partial or incomplete submittals will be returned without review. Submit manufacturer's literature for the following:
 - 1. Handholes (including covers).
 - 2. Conduits and Fittings.
 - 3. Nameplates

1.07 PREVENTION OF CORROSION

All metallic materials shall be protected against corrosion. Exposed metallic parts of outdoor apparatus shall be given a rust-inhibiting treatment and standard finish by the manufacturer. All such parts as boxes, bodies, fittings, guards and miscellaneous parts made of ferrous metals, but not of stainless steel (type 316 or 316L), shall be zinc-coated in accordance with ASTM A153. The Contractor shall not join dissimilar metals directly to each other that will result in deterioration due to galvanic corrosion.

1.08 INSPECTION

Skill and competency of workmanship shall be subject to the approval of Engineer. Notification for inspection shall be given the respective or agencies a minimum of three working days (72 hours) in advance of work.

1.09 GUARANTEE AND CERTIFICATE

As specified in Section 16050 - BASIC MATERIALS AND METHODS.

1.10 CODES, REGULATIONS AND STANDARD SPECIFICATIONS

- A. Work shall conform to latest edition of National Electrical Code.
- B. Applicable rules, standards and specifications of following associations shall apply to materials and workmanship:
 - 1. American National Standards Institute (ANSI)
 - 2. Electronic Industries Association (EIA)
 - 3. National Board of Fire Underwriters (NBFU)
 - 4. National Electrical Manufacturer's Association (NEMA)
 - 5. National Fire Protection Association (NFPA)
 - 6. Underwriters' Laboratories, Inc. (UL)

PART 2 - PRODUCTS

2.01 MATERIALS

- A. All materials shall be new, except as specifically noted, and shall bear the label of Underwriter's Laboratories whenever standards have been established and label service is normally and regularly furnished by the agency.
- B. Contractor shall afford every opportunity for the Engineer to ascertain skill and competency of labor. Concealed work shall be reopened at random as directed during formal inspections by the Engineer or Electrical Inspector.
- C. Ducts:
 - 1. All conduits shall be concrete encased, 3,000 psi minimum, 3" minimum thickness.
 - 2. All concrete encased conduits shall be round bore, PVC Schedule 40 or approved substitute.
 - 3. Conduit and Duct Accessories: Couplings, spacers, plugs, and accessories shall be as recommended by the manufacturer of conduits and ducts and shall be of the same schedule as the ducts to which they are connected.

4. Provide galvanized rigid steel conduits for conduits rising out of the ground.
- D. Wires and Cables:
- Listed for use in underground installations, size and type as indicated on Drawings and is other specification sections.
- E. Wire Mesh: Welded steel wire fabric for reinforcing concrete, galvanized, conforming to ASTM Specification A185.
- F. Backfill Material: As specified in Drawings.
- G. Caulking Compound: Compound for the sealing of conduits, ducts, pipes, and sleeves shall be of a putty-like consistency workable with the hands at temperatures as low as 35 degrees F., shall not slump at a temperature below 300 degrees F., and shall not harden materially when exposed to air for long periods. The compound shall readily adhere to clean surfaces of the following: vitrified clay tile; fiber conduit, fire-clay cement conduit; plastic conduit; concrete; masonry; lead; rubber; polyethylene polychloroprene; or polyvinyl-chloride sheaths of cables; and the common metals. The compound shall form a seal with the foregoing without dissolving, noticeably changing characteristics, or removing any of the ingredients. The compound shall have no injurious effect upon the hands of workmen or upon the materials.
- H. Hardware, Supports, Backing, Etc.: All hardware, supports, backing and other accessories necessary to install electrical equipment shall be provided. Wood materials shall be treated against termites, iron or steel materials shall be galvanized for corrosion protection and non-ferrous materials shall be brass or bronze.

PART 3 - EXECUTION

3.01 GENERAL

- A. As specified in Section 16050 - BASIC MATERIALS AND METHODS.

3.02 INSTALLATION

- A. Trench Excavation:
1. Tone all excavation locations prior to digging. Visually inspect areas around trenching locations for visible signs of underground utilities. Hand excavate near known or suspected locations of existing underground pipes and utilities.
 2. Dimensions and locations of trenches for handholes and ductlines shall be as indicated on drawings. Trench width and depths shall be sufficient to accommodate proper installation of conduit banks.
 3. Should material at bottom of trench for direct buried conduits not be equal to backfill material Type B, the trench shall be excavated an additional 3" to permit backfilling with Type B backfill.

4. Where a trench is excavated on slope, sides are to be vertical, and depth measured at lowest side. All measurements are to be based on final grades.
5. Bottom of trenches to be flat and smooth.
6. Trenches shall be widened at equipment pads and handhole sites to permit proper entry of conduits.
7. All excavations for handholes in excess of the required depths shall be filled with concrete or crushed lava rock.
8. Sheathing and bracing as required shall be provided to support sides of excavations from cave-ins.
9. Provide drainage and pumps to keep trenches dry.
10. Unused excavated material shall be removed off site and disposed of.

B. Backfill:

1. Backfilling shall be to finished grades indicated on accompanying drawings, and matching existing conditions.
2. Backfill material shall be completely free of wood or other debris.
3. Backfill material shall be placed in maximum of 12" layers in loose thickness before compacting. Backfill shall be thoroughly compacted with hand or mechanical tampers to 95% of original compaction and in no case shall tamping be accomplished by using the wheels or tracks of a vehicle. Jetting or flooding of backfill shall not be permitted.
4. A 4" wide warning tape, foil backed, bright orange colored with a black imprinted message similar to "WARNING! STOP DIGGING. ELECTRICAL LINES" shall be placed 12" above concrete encasement or conduit of direct buried ductline over the entire length of ductline installation.
5. Tamp and replant landscaping.

C. Installation of Conduit and Duct Bank:

1. Bottom of trenches for all systems shall be clean, smooth and well graded prior to installation of conduits.
2. Saw cut, ream and taper conduits with manufacturers' approved tool.
3. Couplings and bells shall be tight to prevent entry of dirt or concrete into ducts and conduits.
4. Provide spacers to maintain proper separation between ducts.
5. Changes of direction shall not exceed 4 degrees per length of conduit or duct. Radii and turns shall be made with appropriate duct bends and sweeps. Minimum radius bend for all systems shall be 15'-0". Angled couplings are not

permitted. If factory made bends are to be provided, the contractor shall demonstrate their suitability to the Engineer and inspectors by pulling the respective mandrel completely through the bend prior to installation.

6. Terminate conduits in end-bells where duct lines enter handholes. Separators shall be of precast concrete, high impact polystyrene, steel, or any combination of these. Stagger the joints of the conduits by rows and layers so as to provide a duct line having the maximum strength.
7. Duct lines shall have a continuous slope downward toward handholes and away from buildings with a pitch of not less than 3 inches in 100 feet.
8. Ducts shall be clean and free from debris and rubbish.
9. After each day's work, provide temporary conduit plugs at the end of conduit banks to prevent entry of dirt, rubbish, debris, or concrete.
10. Pass smooth bullet-shaped, blunt tip wooden test mandrel through the entire length of each duct or conduit to test for burrs and obstructions. Unless indicated otherwise, mandrel shall have diameter of 1/2" less than inside diameter of duct. If burrs or obstructions are encountered, that section of ductline shall be replaced at no additional cost to the DOD.
11. Unless indicated otherwise, install polypropylene pullstring in each conduit after testing. Pullstrings shall have a minimum 200 pound tinsel strength. Provide muletape in all telecom conduits 2" and larger.
12. Apply thin coat of sealing compound on ducts and conduits at couplings and bells.
13. Securely anchor duct banks prior to pouring concrete encasement to prevent ducts from floating.
14. When pouring concrete, prevent heavy masses of concrete from falling directly on ducts. If unavoidable, protect ducts with planks.
15. Direct flow of concrete down sides of duct bank to bottom, allowing concrete to rise between ducts, filling all open spaces uniformly.
16. To insure against voids in concrete, work a long, flat splicing bar or spatula liberally and carefully up and down the vertical rows of ducts.
17. Cure concrete for a minimum of 72 hours before permitting traffic and/or backfilling.
18. Provide duct seal on all conduit ends within handholes and where conduits first daylight at buildings (at backboards, inside switchboards, panelboards, cabinets, panels, junction boxes, etc.).
19. A 4" wide warning tape, foil backed, bright orange colored with a black imprinted message similar to "WARNING! STOP DIGGING. ELECTRICAL LINES" shall be placed 12" below finish grade over the entire length of ductline installation.

D. Concrete and Brick Work:

1. Concrete, ready mixed according to ASTM C94-47.
2. Convey concrete from mixer to forms rapidly to prevent segregation. Free drop shall be limited to five feet, unless authorized by inspector.
3. Placing:
 - a. Clean and remove all debris from inside forms and trenches before placing concrete.
 - b. Place concrete only on clean damp surfaces, free from water.
 - c. Place concrete in forms, in horizontal layers not exceeding 18" thickness.
 - d. Place concrete to avoid segregation of materials and displacement of ducts, inserts and reinforcing.
 - e. Vibrate structural concrete thoroughly during and immediately after placing to insure dense watertight concrete.
4. Forming:
 - a. Forms shall be of good sound lumber with sufficient strength and conforming to shapes and dimensions indicated on drawings.
 - b. Forms shall be treated with non-staining form oil immediately before each use.
5. Patching: Patch all voids, pour joints and holes before concrete is thoroughly dry. Use mortar of same proportions as original concrete.
6. Curing: Curing of concrete shall be accomplished by impervious membrane method with liquid membrane compound. Apply two or more coats to obtain a total of one gallon for each 150 square feet of concrete surface.
7. Concrete Brick and Hollow Concrete Block Work:
 - a. Concrete brick and hollow block shall be laid in full bed of mortar, both horizontally and vertically.
 - b. Mortar shall be one part cement and three parts sand, thoroughly mixed and used when fresh. Re-tamping will not be allowed.
 - c. Setting bed shall be of depth required to bring top of blocks flush with finish line.

E. Handhole Installation:

1. Boxes shall be installed approximately where shown. The exact location of each handhole shall be determined after careful consideration has been given to the

location of other utilities, grades and pavement. Handholes shall be of the type noted on the Drawings and shall be constructed in accordance with the applicable details as indicated. A machine-finished seat shall be provided to ensure a perfect joint between frame and cover. Covers shall be machined to prevent rocking within frames. In paved areas, the tops of handhole covers shall be perfectly flush with the finished surface of the paving. In unpaved areas, the top of handhole covers shall be approximately 2-inches above the finished grade.

2. Precast Handhole Installation: Commercial precast assembly shall be set on 6 inches of level, 90 percent compacted crushed rock fill, 3/4-inch to 1-inch size, extending 12 inches beyond the handhole on each side. Granular fill shall be compacted by a minimum of four passes with a plate type vibrator.

F. Structural Steel and Miscellaneous Metal Work:

1. Structural steel work including bolts, nuts, anchors, pulling-in irons, etc. shall be galvanized by hot-dipped process after fabrication into largest practical sections.
2. Reinforcing Steel:
 - a. Clean reinforcing steel of mill or rust scale and form to dimensions indicated.
 - b. Install reinforcing steel in proper locations and secure in place to prevent movement during concrete placing or vibrating.

G. Underground Utilities: Underground utilities indicated on plans are approximate in location. It is not the intention of plans to imply that all existing utilities are drawn and located. It shall be the responsibility of Contractor to coordinate locations of existing utilities prior to doing any excavation work. Any damage to existing and new utilities shall be repaired by Contractor at no cost to the DOD.

H. Cleaning and Repairing:

1. 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, Contractor shall remove from the DOD's property and from all public and private property, at his own expense, all temporary structures, rubbish and waste material resulting from his operations.
2. The Contractor shall restore all removed or damaged pavement, gutters, curbs, sidewalks, sign posts, walkway paintings, trees and landscape damaged by his operations to as near their original condition or better.

3.03 TESTING AND INSPECTION

- A. If the Contracting Officer discovers any errors, the Contractor, at his own expense, shall go over all similar portions of the entire job, taking the necessary or directed remedial action.
- B. The Contractor shall re-tape splices which have been bared for inspection. The Contractor shall test all portions of the electrical system furnished by him for proper

operation and freedom from accidental grounds. All tests shall be subject to the approval of the Engineer.

- C. Installations, 600 volts and less shall be tested for insulation resistance after all wiring is completed and ready for connection to fixtures and equipment. Using a 500V megger, measure and record the insulation resistance from phase to phase and phase to neutral. The above tests shall be witnessed by the Contracting Officer and the records turned over to him for proper disposition. The Contractor shall notify the Contracting Officer when this test is to be performed.
- D. Wherever test or inspection reveals faulty equipment or installation, the Contractor shall take corrective action, at his own expense, repairing or replacing equipment or installation as directed.
- E. Ground-Resistance Measurements: Ground-resistance measurements for each ground rod shall be made and certified by the Contractor. Upon completion of the project, Contractor shall submit in writing to the Contracting Officer the measured ground resistance of each ground rod and grounding system, as well as the resistance and soil conditions at the time the measurements were made, for approval by the Engineer.

END OF SECTION

SECTION 16530 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.01. GENERAL REQUIREMENTS

As specified in Section 01001.

1.02. DESCRIPTION OF WORK

A. Work Included: The Contractor shall furnish all labor, materials (except as hereinafter noted), tools, equipment and appliances required to provide and install all Electrical Work, complete, as indicated on the drawings and/or as herein specified. The drawings note various sizes of equipment as determined for basis of design; the electrical work, however, shall be installed to comply with the equipment furnished by the successful supplier. The work shall include but not necessarily be limited to, the following:

1. Provide new parking lot lighting system and light pole assemblies including light poles, luminaires and concrete foundations.
2. Provide new underground secondary electrical distribution system for new light pole assemblies including underground wiring and pullboxes.
3. Before bidding on this work, carefully examine each of the drawings and the site. By submitting a proposal of the work included in this contract, the Contractor shall be deemed to have made such examination and to be familiar with and accept all conditions of the job site.
4. Test complete installation and correct all defects and malfunctions of material and workmanship at no additional charge to the Department of Defense (DOD).

B. Related Requirements: Section 16050 – BASIC MATERIALS AND METHODS, applies to this section, with the additions and modifications specified herein.

1.03. SUBMITTALS

A. Submit in accordance with Section 01300 – SUBMITTALS.

B. Product Data and Drawings:

1. LED Luminaires
2. Light pole assemblies including dimensions, accessories, installation and construction details. Include dimensions, wind load determined in accordance with AASHTO LTS2, pole deflection, pole class, and other applicable information.

3. Precast pullboxes including frame and cover.
4. Conduit.
5. Conductors.

C. Photometric Data and Illumination Calculations:

1. Photometric data certified by an independent testing laboratory. Testing shall be in accordance with IESNA LM-79-2008 test methods. Test report shall include laboratory name, report number, date, luminaire catalog number and luminaire/light source specifications. Excerpts of test data on manufacturer's letterhead are not acceptable. Relative or scaled photometric data is not acceptable.
2. Test data for lumen maintenance of LED light sources. Testing shall be in accordance with IESNA LM-80-2008 test methods.
3. Photometric Data in IES Format: Provide photometric data for the specific luminaire provided in ANSI/IESNA LM-63-02 format. Multiple files or a library of photometric data is unacceptable.
4. Illumination Calculations: provide illumination calculations for the areas indicated on the drawings. The calculations shall be plotted on 11 inches x 17 inches or 24 inches x 36 inches paper and shall include summary tables. The summary tables shall include the luminaire description and calculation results. Calculations shall include maintained minimum, average, and maximum footcandle levels. Calculations shall also include maximum/minimum and average/minimum uniformity ratios. Point-to-point footcandle values shall be provided at 10 feet on center horizontally within the indicated calculation area. Calculations shall utilize a 0.8 light loss factor.

D. Intent of Shop Drawing Review:

1. Shop drawing and catalog cut submittals processed by the Officer-in-Charge are not change orders. The purpose of the submittals by the Contractor is to demonstrate to the Officer-in-Charge that he understands the design concept, that he demonstrates his understanding by indicated which equipment and material he intends to furnish and install and by detailing the fabrication and installation methods he intends to use.

- E. Shop drawings and catalogue 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

catalogue cuts shall not release Contractor from complying with intent of specification and drawings.

1.04. GUARANTEE AND CERTIFICATE

Any item of material, apparatus, equipment furnished and installed, or construction by the Contractor showing defects in design, construction, quality or workmanship within one year from the date of final acceptance by the DOD shall be replaced by such new material, apparatus or parts as may be found necessary to make such defective portion of the complete system conform to the true intent and meaning of the specification and/or the drawings. Exceptions shall be fluorescent lamps which shall be guaranteed for one half of the manufacturer's listed life time. Such repairs or replacement shall be made by the Contractor or his surety, free of all expense to the DOD.

1.05. DELIVERY, STORAGE AND HANDLING

Do not store poles on ground. Support poles so they are at least one foot above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

PART 2 - PRODUCTS

2.01. MATERIALS

A. Light Fixtures: Provide LED light fixtures complete with necessary lamps, drivers, starters, and accessories, according to plans. Projected lumen maintenance shall be minimum of 94.26% at 100,000 hours.

1. LED Fixtures:

a. General:

- (1) UL 1598 Standard for Luminaires.
- (2) UL 8570 Standard for Safety for LED Equipment for use in Lighting Products.
- (3) RoHS compliant.
- (4) The LED luminaire shall be surface wall/pole mounted with IESNA Type III distribution, 120 to 277V input electronic driver, textured natural aluminum and vandal resistant polycarbonate lens.

b. Housing: Housing shall be one-piece die-cast, low copper (<0.6% Cu) aluminum alloy with integral cooling ribs over the optical chamber and electrical compartment, solid barrier wall to separate optical and electrical compartments. Single die-cast aluminum cam-latch shall provide positive locking and sealing of the optical chamber. Latch shall have a captive stainless steel flat socket head screw to prevent unauthorized opening of the

luminaire. A one piece extruded and vulcanized silicone gasket shall seal the housing against the lens surface.

- (1) Dimensions: Less than 27 inches long, 15 inches wide and 4 1/2 inches tall
 - (2) Weight: Luminaire shall not weigh more than 30 pounds
- c. Lens: One-piece flat polycarbonate lens retained by a stainless steel piano hinge and a single die-cast aluminum cam-latch. Edges shall be camouflaged to conceal the outer portion of the housing.
- d. Optical Module: Precision, replaceable PicoEmitters positioned to achieve directional control toward desired task. The entire EmitterDeck shall be fastened to the housing as a one-piece module.
- (1) IES Distribution Pattern: Type III
 - (2) Luminaire Classification System (LCS): B1-U0-G1
- e. Electrical Module: All electrical components shall be UL and CSA recognized and mounted on a single plate and factory pre-wired with quick disconnect plugs. Module shall include a driver, thermal control device and surge protector. Fixture to be provided with 0-10V dimming driver. Electrical module shall attach to the housing with no-tool hinges and latches. Driver shall be rated for -40 degrees F starting.
- (1) Input Voltage: 120 volts
 - (2) Electrical Drive Current: 0.66 and 1.13 amperes
 - (3) System Wattage: 79 watts at 660 mA and 166 Watts at 1380 mA
 - (4) Power Factor: 0.9 minimum
- f. Light Source:
- (1) Correlated Color Temperature (CCT): 3000K nominal
 - (2) Color Rendering Index (CRI): 70 minimum
 - (3) Absolute Lumens: 8,852 minimum at 660 mA and 17,074 minimum at 1380 mA
 - (4) Projected Lumen Maintenance: 94.26% minimum at 100,000 hours
- g. Finish: Fade and abrasion resistant, electrostatically applied,

thermally cured, triglycidal isocyanurate (TGIC) polyester powder coat. The finish shall pass a 2,500 hour salt spray endurance test.

- h. Support Arm: Heavy cast, low copper aluminum alloy with stainless steel mounting bolts and pole reinforcing plate with wire strain relief. Provide 2 inch pipe size vertical slip-fitter mount for 2 3/8 inches by 4 1/2 inches tenon.
- i. Light Spill: Luminaires shall be able to control spill light without the need for a house side shield.
- j. Warranty: A warranty must be provided for full replacement of the luminaire due to any failure for a period of 5 years. The warranty shall provide for the repair or replacement of metal parts and LED power components (LED driver, thermal control device and surge protector). For full warranty, see <https://lithonia.acuitybrands.com/>.
- k. Lithonia Lighting KAXW-P3-30K-MVOLT-PIRH1FC3V-LCE/RCE-CLA/DNATXD and DSXO LED-P7-30K-TFTM-MVOLT-SPA-KMA8 DDBXD U-PIRH1FC3V-CLA/DNATXD or approved equivalent

PART 3 - EXECUTION

3.01. INSTALLATION

- A. Fixture Supports: ANSI C2, NFPA 70.
 - 1. Every outlet box or other support for light fixtures shall be of sufficient strength to support at least 4 times the weight of the fixture.
 - 2. Support all fixtures weighing more than 50 lbs. independently of the outlet box.
 - 3. Fixtures shall be securely and safely supported by means of fixture studs in the outlet boxes or other approved means. Ceiling fixtures shall be arranged to hang vertically unless otherwise directed by the DOD. Provide accessories such as straps, mounting plates, nipples, or brackets for proper installation.
 - 4. Where ceiling construction is such that mounting channels, strong backs, etc., are required to properly support fixtures, provide these supports under Electrical Work, unless otherwise specified or shown on plans. Refer to architectural drawings for type, style and pattern of ceiling construction.
 - 5. Set light fixtures plumb, square, and level with ceiling and walls, in alignment with adjacent lighting fixtures, and secure in accordance with manufacturers' directions. The installation shall meet with the requirements of NFPA 70. Mounting heights specified or indicated

shall be to bottom of fixture for ceiling-mounted fixtures and to center of fixture for wall-mounted fixtures. Recessed fixtures may be supported from suspended ceiling support system ceiling tees when the ceiling system support wires, straps or rods are provided at a minimum of four wires, straps or rods per fixture and located not more than 6 inches from each corner of each fixture. For recessed fixtures, provide support clips securely fastened to ceiling grid members, a minimum of one at or near each corner of each fixture. Do not support round fixtures by ceiling acoustical panels, support such fixtures independently, with a minimum of four straps or rods per fixture, or with at least two 3/4 inch metal channels spanning, and secured to, the ceiling tees. Provide straps or rods for lighting fixture support in this section.

6. Suspended fixtures shall be provided with swivel hangers in order to insure a plumb installation. Pendants 4 feet or longer shall be braced to limit swinging. Single-unit suspended fluorescent fixtures shall have twin-stem hangers. Multiple-unit or continuous-row fluorescent units shall have a tubing or stem for wiring at one point, and a tubing or rod suspension provided for each length of chassis including one at each end. Maximum distance between adjacent tubing and stems shall be 10 feet. Rods shall be of not less than 3/16-inch diameter.

3.02. TESTING AND INSPECTION

Contractor shall conduct at least one night inspection of the exterior lighting systems. Luminaries and lighting control systems shall be tested for proper operation

- A. Test equipment for foot-candle level measurements shall be Minolta cosine corrected T-1 light meter or an pre-approved substitute. Meter shall be calibrated and certified within the previous 12 months and shall be utilized together with factory remote mounting and cabling to avoid shadowing or reflection into the test cell.
- B. Testing shall be done after 100 hours of lamp operation, per IES.
- C. For final approval of the project, the Contractor shall provide a final report from the test results. As a minimum, the following items shall be included:
 1. Names of all personal present during testing, including name of company, address, and telephone and fax number.
 2. Identification of number and location of test stations matching the number and locations indicated on the "approved" shop drawing light level calculations.
 3. Record actual foot-candle readings and height above finish grade reading was taken. Test heights shall conform to the "approved" shop drawing light level calculations.
 4. Number of hours of operations and system starts at time of testing.

END OF SECTION

SECTION 16660 - VEHICLE DETECTOR LOOP

PART 1 - GENERAL

1.01. GENERAL REQUIREMENTS

As specified in Section 01001.

1.02. DESCRIPTION OF WORK

- A. Work Included: The Contractor shall furnish all labor, materials (except as hereinafter noted), tools, equipment and appliances required to provide and install all Vehicle Detector Loop Work, complete, as indicated on the drawings and/or as herein specified. The drawings note various sizes of equipment as determined for basis of design; the vehicle detector loop work, however, shall be installed to comply with the equipment furnished by the successful supplier. The work shall include but not necessarily be limited to, the following:
1. Installing vehicle detector loops in accordance with this special provision and the standard details and identifying the locations of existing vehicle detector loops and removing them.
 2. Before bidding on this work, carefully examine each of the drawings and the site. By submitting a proposal of the work included in this contract, the Contractor shall be deemed to have made such examination and to be familiar with and accept all conditions of the job site.
 3. Test complete installation and correct all defects and malfunctions of material and workmanship at no additional charge to the State Department of Defense (DOD).
- B. Related Requirements: Section 16050 – ELECTRICAL BASIC MATERIALS AND METHODS, applies to this section, with the additions and modifications specified herein.

1.03. SUBMITTALS

- A. Submit in accordance with Section 01300 – SUBMITTALS.
- B. Shop Drawings: Submit complete shop drawings and manufacturer's literature for the Engineer's review before any work is ordered or fabricated. Partial or incomplete submittals will be returned without review. Submit manufacturer's literature for the following:
1. Vehicle Detector Loop Cable
 2. Backer Rod
 3. Sealant

C. Intent of Shop Drawing Review:

1. Shop drawing and catalog cut submittals processed by the Officer-in-Charge are not change orders. The purpose of the submittals by the Contractor is to demonstrate to the Office-in-Charge that he understands the design concept, that he demonstrates his understanding by indicated which equipment and materials he intends to furnish and install and by detailing the fabrication and installation methods he intends to use.

- D. Shop drawings and catalogue 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 catalogue cuts shall not release Contractor from complying with intent of specification and drawings.

1.04. GUARANTEE AND CERTIFICATE

Any item of material, apparatus, equipment furnished and installed, or construction by the Contractor showing defects in design, construction, quality or workmanship within one year from the date of final acceptance by the State DOD shall be replaced by such new material, apparatus or parts as may be found necessary to make such defective portion of the complete system conform to the true intent and meaning of the specification and/or the drawings.

1.05. DELIVERY, STORAGE AND HANDLING

Store Pro-Seal loop sealant only in its original container in a dry and cool place, in accordance with local regulations. Keep away from heat, sparks, flame, and other sources of ignition. Take precautionary measures against static discharges. Use spark-proof tools and explosion-proof equipment. All equipment used when handling the product must be grounded.

PART 2 - PRODUCTS

2.01. MATERIALS

- A. Vehicle Detector: Vehicle Detector shall be the MX4621 HY-5B Loop Detector compatible with the existing gate control system or approved equal.
- B. Vehicle Detector Loop Cable: Vehicle Detector Loop Cable shall be Type 4 Cable, Solid No. 12 AWG, Single Conductor, 600 Volt, General Purpose Cable for Sensor Loops or as recommended by the gate controller manufacturer. Conforming to requirements of IMSA specifications 51-5.

1. Conductor: Conductor shall be No. 12 AWG, solid copper conductor.
2. Insulation: Insulation shall be of moisture and heat resistant rubber with a minimum thickness of 3/64 of an inch. The outside diameter of the conductor shall be approximately 0.25 inch.
3. Two-way conduit stub out and other materials are to be installed as required.
4. Joint Sealer for Vehicle Detector Loops shall be epoxy or approved equal..

C. Hot Tar Sealant for Sensor Loops:

1. The hot applied rubberized sealant shall be formulated specifically to be flexible. It shall be suitable for use as a sealant for industrial wire loops imbedded in asphalt concrete and Portland cement concrete for traffic signal work and vehicle counters, and shall be non-tracking under traffic. At application temperatures, the rubberized sealant shall be a thin, free-flowing fluid that penetrated saw cuts and self-levels to permit uniform applications. The sealant shall be melted and applied to pavements using a pressurized application unit. The sealant shall be relatively stiff, but shall remain flexible at low pavement surface temperatures. Test results shall conform to the following specifications.

TEST	SPECIFICATION
Penetration, 77°F	25 – 35 maximum
Flow, 140°F	0 mm – 5mm maximum
Resilience, 77°F	40 percent minimum
Softening Point	180 F minimum
Ductility, 77°F	30 cm minimum
Mandrel bend, 0°F, 180°F, 5s	½ inch diameter
Rec. Pour Temperature	180°F
Safe Heating Temperature	410°F
375°F Viscosity	30 Poise
Unit Weight	10.0 pounds/gallon
Coverage, ½ inch x ½ inch crack	13.0 pounds per 100 feet

D. Directions for Use:

1. Saw cuts shall be blown clean and dry with compressed air to remove all excess moisture and debris. For repairing damaged saw cuts, all loose spalled material shall be cleaned away from saw cut, chipping back to sound asphalt concrete or Portland cement concrete and all loose material cleaned from loop wires. Sealant temperature at application should be 370°F and should not exceed 420°F. Loop detector sealant should be placed to a maximum height above the pavement of 1/8 inch, with a slight overlap of sealant on the sides of the pavement cut.

PART 3 - EXECUTION

3.01. INSTALLATION

- A. Vehicle loop sensors shall be installed in accordance with the details shown on the plans and standard details and per manufacturer's instructions.
- B. The locations of vehicle sensor loops as shown on the project plans are approximate. Exact locations shall be determined in the field by the Contractor.
- C. After reconstruction of pavement area, with a power saw, cut a slot deep enough in the road surface for the number of wires to be installed.
 1. Do not cut the slot unnecessarily deep. Keep the loop as close to the surface as possible, away from metal reinforcing.
 2. The width of the slot is approximately 3/8 inch.
 3. Knock off all sharp edges or corners of the saw slot that might damage insulation.
 4. Clean debris from saw slot with compressed air and allow surface and slot to completely dry.
 5. Place one inch of sand (or as indicated on the drawings) in saw slot as necessary.
- D. Using Type 4 cables, construct the loop.
 1. Use four (4) turns per loop, unless otherwise directed by the Officer in Charge.
 2. Tramp the wire all the way down in the slot using a blunt wooden instrument. (Do not use a screwdriver or sharp object that might skin the insulation.)
 3. The wire should not be pulled tight in the saw slot as a hot joint sealer may cause expansion.

4. After the detector loop is properly installed, hold the loop in place with strips of rubber, neoprene, flexible tubing, or foam backer rod as approved by the Engineer. Ensure that backer rod material is non-metallic, is placed in the saw slot per manufacturer's instructions, and that the distance from the top of the hold down material to the final surface of the roadway is not less than 1.5 inches.
- E. Seal the slot in the road surface with hot tar, or last production of 3M Epoxy detector sealant.
- F. Connect new loop detector wiring to existing loop detector module in existing controller.
- G. Restore to their original condition, existing pavements and other improvements, such as driveways, sidewalks, curbs and gutters, disturbed by excavation. Use replacement material equal to or better in quality than existing materials. Match existing grades, thickness, and color whenever applicable.

3.02. TESTING AND INSPECTION

- A. Contractor shall perform a functional test to ensure existing gate control system operates properly with the new loop detectors. Reprogram controller as necessary. Replace or repair any fault in the material or installation revealed by these tests. Repeat same test until no fault appears.

END OF SECTION