REQUIREMENTS and SPECIFICATIONS

TO CONSTRUCT

DIAMOND HEAD SEWER LIFT STATION
EMERGENCY GENERATOR
STATE JOB NO: CA-1802-D
TAX MAP KEY: 3-1-042:006
HONOLULU, OAHU, HAWAIʻI

FOR THE **STATE OF HAWAIʻI, DEPARTMENT OF DEFENSE**

MAY 2018

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DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01100 - PROJECT REQUIREMENTS

PART 1 - GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Identification: Project consists of installation of a standby generator and skid mounted diesel fuel tank, selective site demolition, earthwork, concrete work, grassing and site restoration, site work and miscellaneous related work.
   1. Project Location: Diamond Head State Monument, Honolulu, Oahu, Hawaii

B. Perform operations and furnish equipment, fixtures, appliances, tools, materials, related items and labor necessary to execute, complete and deliver the Work as required by the Contract Documents.

C. The Division and Sections into which these specifications are divided shall not be considered an accurate or complete segregation of work by trades. This also applies to work specified within each section.

D. Contractor shall not alter the Drawings and Specification. If an error or discrepancy is found, notify the Engineer.

E. Specifying of interface and coordination in the various specification sections is provided for information and convenience only. These requirements in the various sections shall complement the requirements of this Section.

1.02 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
   1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated and include incomplete sentences. Omission of words or phrases such as “the Contractor shall”, “as shown on the drawings”, “a”, “an”, and “the” are intentional. Omitted words and phrases shall be provided by inference to form complete sentences. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred, as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates. Where devices, or items, or parts thereof are referred to in the singular, it is intended that such reference shall apply to as many such devices, items or parts as are required to properly complete the Work.

   2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.

a. The words “shall”, “shall be”, or “shall comply with”, depending on the context, are implied where a colon (:) is used within a sentence or phrase.

3. Abbreviations and Acronyms for Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale Research’s “Encyclopedia of Associations” or in Columbia Books’ “National Trade & Professional Associations of the U.S.”.

B. Terms:
1. Directed: Terms such as “directed”, “requested”, “authorized”, “selected”, “approved”, “required”, and “permitted” mean directed by Engineer, requested by Engineer, and similar phrases.

2. Indicated: The term “indicated” refers to graphic representations, notes, or schedules on drawings or to other paragraphs or schedules in specifications and similar requirements in the Contract Documents. Terms such as “shown”, “noted”, “scheduled”, and “specified” are used to help the user locate the reference.

3. Furnish: The term “furnish” means to supply and deliver to project site, ready for unloading, unpacking, assembly, and similar operations.

4. Install: The term “install” describes operations at project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

5. Provide: The terms “provide” or “provides” means to furnish and install, complete and ready for the intended use.

6. Installer: An installer is the Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-Subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

7. Submit: Terms such as “submit”, “furnish”, “provide”, and “prepare” and similar phrases in the context of a submittal, means to submit to the Engineer.

C. Industry Standards:
1. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

2. Publication Dates: Comply with standards in effect as of date of the Contract Documents, unless otherwise indicated.

3. Conflicting Requirements: If compliance with 2 or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Engineer for a decision before proceeding.

1.03 WORK SEQUENCE

A. The Work will be conducted in a single construction phase.

1.04 USE OF PREMISES AND WORK RESTRICTIONS

A. General: Contractor shall have full use of construction area for construction operations, including use of project site, during construction period.

B. Contractor's use of premises is restricted as follows:
   1. Construction Times and Schedule: Night, weekend and overtime work is allowed unless restricted elsewhere.

   2. Site Access and Parking:
      a. Parking: Parking for the Contractor's employees (or Subcontractors) will be limited to the available areas within the designated Project Contract Limits or in areas designated by the Engineer. Do not use parking stalls in regularly designated parking zones within the grounds. Unauthorized vehicles parked in marked stalls and in any area outside of the designated project construction site will be subject to towing at the Contractor's expense.

      b. Maintain access to the Loading area through Project Contract Limits.

   3. Sanitation: Use of toilet facilities will be as directed by the Engineer. Facilities shall be kept clean. Abuse of this condition may result in the Contractor providing their own toilet facilities at no additional cost to the State.

C. Noise and Dust Control:
      a. In adjacent locations surrounding the project site, noise, dust and other disrupting activities, resulting from construction operations, are detrimental to conduct of Facility activities. Therefore, Contractor shall monitor its construction activities. Exercise precaution when using equipment and machinery to keep the noise and dust levels to a minimum.

      b. To reduce loud disruptive noise levels, ensure mufflers and other devices are provided on equipment, internal combustion engines and compressors.

      c. The Engineer will require any construction activity that produces excessiveness of noise and dust to be performed during an agreed-on period by the Department of Defense. The Engineer shall make the final determination. Overtime costs for the Contractor's employees and work force are the Contractor's responsibility.

2. Other Conditions:
    a. Arrange for construction debris and trash to be removed from project site weekly.

    b. Operate machinery and equipment with discretion and with minimum interference to driveways and walkways. Do not leave machinery and equipment unattended on roads and driveways.

    c. Store materials in the areas as designated by the Engineer. Locate construction equipment, machinery, equipment and supplies within the Project Contract Limits.

    d. Keep access roads, to the project site free of dirt and debris. Provide, erect and maintain lights, barriers, signs, etc. when working on roads, driveways and walkways to protect pedestrians and moped/bicycle riders. Obey traffic and safety regulations.

    e. The Contractor is notified that the Diamond Head State Monument will remain operational during the entire period of this project. The Contractor shall schedule his work and operations in such a manner as to minimize disturbances and hazards. Safe access and egress around the project site shall be maintained at all times. Any and all disruptions of access, etc. shall be coordinated in writing with the Contracting Office and facility and identified in the work schedule. Any and all construction aids necessary to maintain normal operation of the facility and to protect the public and staff shall be the responsibility of the Contractor.

1.05 WORK UNDER OTHER CONTRACTS

A. Separate Contract: The State may execute a separate contract for certain construction at the project site that was not known at the time Offers were submitted.

B. Separate Contract: The State has awarded a separate contract for performance of certain construction operations at project site. Those operations may be conducted simultaneously with work under this Contract.
    1. A separate contract has been awarded for improvements to the Diamond Head Lift Station. The project is as follows:
        a. Diamond Head State Monument, Sewer Lift Station Replacement
        DLNR Job No. F37C614E

    2. A separate contract has been awarded for site and roadway improvements to the Kahala Tunnel. The project is as follows:
        a. Diamond Head State Monument, Traffic Control Improvements, Kahala Tunnel
        DLNR Job No. F37C614D

C. Cooperate fully with separate Contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract.

1.06 FUTURE WORK

A. It is not anticipated the State will award a future contract that depends on the Work under this contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01310 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
   1. General project coordination procedures.

   2. Project meetings.

1.02 PERFORMANCE AND COORDINATION

A. Contractor is in charge of the Work within the Project Contract Limits and shall direct and schedule the Work. Include general supervision, management and control of the Work of this project, in addition to other areas more specifically noted throughout the Specifications. Final responsibility for performance, interface, and completion of the Work and the Project is the Contractor's.

B. The Contractor is responsible for jobsite Administration. Provide a competent superintendent on the job and provide an adequate staff to execute the Work. In addition, all workers shall dress appropriately and conduct themselves properly at all times. Loud abusive behavior, sexual harassment and misconduct will not be tolerated. Workers found in violation of the above shall be removed from the job site as directed by the Engineer.

C. The State will hold the Contractor liable for all the acts of Subcontractors and shall deal only with the Prime Contractor in matters pertaining to other trades employed on the job.

D. Coordination: Provide project interface and coordination to properly and accurately bring together the several parts, components, systems, and assemblies as required to complete the Work pursuant to the GENERAL CONDITIONS and SPECIAL CONDITIONS.
   1. Provide interface and coordination of all trades, crafts and subcontracts. Ensure and make correct and accurate connections of abutting, adjoining, overlapping, and related work. Provide anchors, fasteners, accessories, appurtenances, and incidental items needed to complete the Work, fully, and correctly in accordance with the Contract Documents.

   2. Provide additional structural components, bracing, blocking, miscellaneous metal, backing, anchors, fasteners, and installation accessories required to properly anchor, fasten, or attach material, equipment, hardware, systems and assemblies to the structure.

   3. Provide excavation, backfilling, trenching and drilling for trades to install their work.

   4. Provide concrete foundations, pads, supports, bases, and grouting for trades as needed to install their work.

5. Equipment, appliances, fixtures, hardware, and systems requiring electrical services shall be provided with such electrical services, including outlets, switches, overload protection, interlocks, panelboard space, disconnects, circuit breakers, and connections.

6. Materials, equipment, component parts, accessories, incidental items, connections, and services required to complete the Work which are not provided by Subcontractors shall be provided by the Contractor.

7. Coordination: Coordinate construction operations included in various Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

1.03 COOPERATION WITH OTHER CONTRACTORS

A. The State reserves the right at any time to contract for or otherwise perform other or additional work within the Project Contract Limits. The Contractor of this project shall to the extent ordered by the Engineer, conduct its work so as not to interfere with or hinder the progress or completion of the work performed by the State or other Contractors.

1.04 COORDINATION WITH OTHER PRIME CONTRACTORS

A. Multiple prime Contractors performing work under separate agreements with the State may be present near the project location, adjacent to and abutting the Project Contract Limits. This Contractor shall coordinate activities, sequence of work, protective barriers and any and all areas of work interfacing with other Prime Contractor's work. Contractor shall provide a continuity of finishes, walks, landscape, etc. at abutting Contract Limits so no additional work will be required. Any damage to other Prime Contractor's Work committed by this Contractor (or its Subcontractor) shall be repaired promptly at no additional cost to the State.

B. Coordinate Subcontractors and keep them informed of any work from the other Projects that may affect the site or the Subcontractor's work. If the Contractor has any questions regarding its coordination responsibilities or needs clarification as to the impact in scheduling of its work and the work of other projects, this Contractor shall notify the Engineer in writing.

C. Subject to approval by the Engineer, this Contractor shall amend and schedule its work and operations to minimize disruptions to the work and operations of other projects.
   1. Relocate or remove and replace temporary barriers, fencing supports or bracing to allow work by others to proceed unimpeded. Do not remove required barriers supporting work until specified time or as approved by the Engineer. This does not relieve the Contractor of the responsibility of proper coordination of the work. If directed by the Engineer, leave in place any temporary barriers.

2. Coordinate work that abuts or overlaps work of the other projects with the Engineer and other Prime Contractors to mutual agreement so that work is 100 percent complete with continuity of all materials, systems and finishes.

3. When directed by the Engineer, provide access into the construction zone to allow the other project's Contractor(s) to perform their Work and work that must be interfaced.

4. Contractor shall adjust and coordinate its Work and operations as required by the other projects as part of the Work of this contract without additional cost or delay to the State.

5. When directed by the Engineer provide a combined Contractor's construction schedule.

D. Other Contracts: If known, they are listed in SECTION 01100 - PROJECT REQUIREMENTS.

1.05 SUBMITTALS

A. Submit in accordance with SECTION 01330 - SUBMITTAL PROCEDURES.

B. Photo Documentation: Prior to the start of jobsite work, the Contractor shall photo document the existing conditions at the site and file with the Engineer one complete set of documents.

C. Reporting: Submit meeting minutes and schedule updating as specified.

D. Combined Contractor's Construction Schedule: Provide schedule as determined by Engineer for coordination with other prime Contractors.

1.06 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences as directed by the Engineer.
   1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Engineer of scheduled meeting dates and times.

   2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.

   3. Minutes: Contractor record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Engineer, within 7 days of the meeting.

B. Preconstruction Conference: Engineer shall schedule a preconstruction conference before the start of construction, at a time convenient to the Engineer, but no later than 7 days before the Project start date or jobsite start date whichever is later. Conference will be held at the Project site or another convenient location. The Engineer shall conduct the meeting to review responsibilities and personnel assignments.

1. Attendees: Engineer, and Design Consultants; Facility Users; Contractor and its superintendent; major Subcontractors; manufacturers; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with the Project and authorized to conclude matters relating to the Work.

2. Agenda: Discuss items of significance that could affect progress, including the following:
   a. Tentative construction schedule.

   b. Phasing.

   c. Critical work sequencing and coordination.

   d. Designation of responsible personnel.

   e. Use of the premises.

   f. Responsibility for temporary facilities and controls.

   g. Parking availability.

   h. Office, work, and storage areas.

   i. Equipment deliveries and priorities.

   j. First aid.

   k. Security.

   l. Progress cleaning.

   m. Working hours.

C. Progress Meetings: Conduct progress meetings at bi-monthly or other intervals as determined by the Engineer. Coordinate dates of meetings with preparation of payment requests.
   1. Attendees: In addition to Engineer, each Contractor, Subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

   2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
      a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule

revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

b. Review present and future needs of each entity present, including the following:
   1) Outstanding Requests for information (clarification).
   2) Interface requirements.
   3) Sequence of operations.
   4) Status of outstanding submittals.
   5) Deliveries.
   6) Off-site fabrication.
   7) Access.
   8) Site utilization.
   9) Temporary facilities and controls.
   10) Work hours.
   11) Hazards and risks.
   12) Progress cleaning.
   13) Quality and work standards.
   14) Force Account work.
   15) Change Orders and Change Proposals.
   16) Documentation of information for payment requests.

c. Corrective Action Plan: Contractor shall provide a plan of corrective action for any item which is delayed or expected to be delayed, then that item impacts the contractual dates.

3. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.
   a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01320 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
   1. Contractor's Construction Schedule.
   2. Submittals Schedule.
   3. Schedule of Prices.
   4. Payment Application.

B. Related Sections include the following:
   1. SECTION 01310 - PROJECT MANAGEMENT AND COORDINATION for preparing a combined Contractor's Construction Schedule.
   2. SECTION 01330 - SUBMITTAL PROCEDURES for submitting schedules and reports.

1.02 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
   1. Critical activities are activities on the critical path and control the total length of the project. They must start and finish on the planned early start and finish times.
   2. Predecessor activity is an activity that must be completed before a given activity can be started.

B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of project.

C. Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall Project duration and contains no float.

D. Event: The starting or ending point of an activity.

E. Float: The measure of leeway in starting and completing an activity.
   1. Float time is not for the exclusive use or benefit of either State or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.

2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the following activity.

3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

F. Schedule of Prices: A statement furnished by Contractor allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Payment Applications.

1.03 SUBMITTALS

A. Submit in accordance with SECTION 01330 - SUBMITTAL PROCEDURES.

B. Required Submittals: Submit 3 sets of the list of the required submittals, by Specification Section, within 15 days after award of the contract or upon earlier written instructions from the Engineer.
   1. The listing shall indicate and include the following:
      a. The number of copies required for submittal.

      b. Planned submittal date.

      c. Approval date required by the Contractor.

      d. A space where the "date of submittal" can be inserted.

      e. A space where the "date of approval" can be inserted.

      f. A space where an "action code" can be inserted.

C. Construction Schedule: Submit 7 sets of the Construction Schedule for review within 15 days after the award of the contract or upon earlier written instructions from the Engineer.

D. Schedule of Prices: Submit 3 sets of the Schedule of Prices for review within 15 days after the award of the contract or upon earlier written instructions from the Engineer.
   1. Use the Department's forms for Payment applications

E. Payment Application: Submit the payment application at earliest possible date and no sooner than the last day of the month after all payroll affidavits, updated submittal registers, and schedules have been submitted.

1.04 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate Contractors.

B. Construction Schedule: Coordinate Contractor's Construction Schedule with the Schedule of Prices, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
   1. Secure time commitments for performing critical elements of the Work from parties involved.

2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

C. Schedule of Prices: Coordinate preparation of the schedule with preparation of Contractor's Construction Schedule.
   1. Correlate line items in the Schedule of Prices with other required administrative forms and schedules, including the following:
      a. The Department's Payment Application form and the Construction Progress Report continuation sheet.

      b. Submittals Schedule.

PART 2 - PRODUCTS

2.01 SUBMITTALS SCHEDULE

A. Comply with the GENERAL CONDITIONS "SHOP DRAWINGS AND OTHER SUBMITTALS" section. Furnish required submittals specified in this Section and in the Technical Sections. Submittals include one or more of the following: shop drawings, color samples, material samples, technical data, material safety data information, schedules of materials, schedules of operations, guarantees, certifications.

B. Preparation: Furnish a schedule of submittals per Engineer.
   1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Prices, and Contractor's Construction Schedule.

   2. The schedule shall accommodate a minimum of 21 calendar days for the State's review, as applicable for the Island the project is located.

   3. Prepare and submit an updated list to the Engineer at monthly intervals or as directed by the Engineer. The listing shall reflect all approvals received since the last update.

2.02 CONTRACTOR'S CONSTRUCTION SCHEDULE - PERT CHART CRITICAL PATH METHOD (CPM)

A. The construction schedule shall address the entire project, to the extent required by the Contract Documents, and shall show an expedient and practical execution of work. If requested by the Engineer, the Contractor shall participate in a preliminary meeting to discuss the proposed schedule and requirements prior to submitting the schedule.

B. The Construction Schedule shall indicate the following:
   1. Elements of the Project in detail time scaled by month or by week, and a project summary.

   2. The order and interdependence of activities and the sequence in which the work is to be accomplished.

3. How the start of a given activity is dependent upon the completion of preceding activities and how its completion restricts the start of following activities.

4. The submittal and approval of shop drawings, samples, procurement of critical materials and equipment, receipt of materials with estimated costs of major items for which payment will be requested in advance of installation, fabrication of special materials and equipment, and their installation and testing.

5. Activities of the State that have an effect on the progress schedule, such as the required delivery dates for State furnished materials and equipment and other similar items.

6. Provide a separate report with the following:
   a. The description of the activity and the duration of time in calendar days.

   b. The duration of time in calendar days.

   c. For each activity indicate the early start date.

   d. For each activity indicate the early finish date.

   e. For each activity indicate the late start date.

   f. For each activity indicate the late finish date.

   g. Total float time.

   h. Cost of event.

   i. Contract-required dates for completion of all or parts of the Work.

   j. Events are to be used on “Monthly Progress Report” for monthly payment request.

C. Upon completion of the Engineer’s review, the Contractor shall amend the schedule to reflect the comments. If necessary, the Contractor shall participate in a meeting with the Engineer to discuss the proposed schedule and changes required. Submit the revised schedule for review within 7 calendar days after receipt of the comments.

D. Use the reviewed schedule for planning, organizing and directing the work, for reporting progress, and for requesting payment for the work completed. Unless providing an update, do not make changes to the reviewed schedule without the Engineer’s approval.

E. Should changes to the schedule be desired, submit a request in writing to the Engineer and indicate the reasons for the proposed change. If the changes are major, the Engineer may require the Contractor to revise and resubmit the schedule at no additional cost to the State. Contractor shall mitigate the impact

of all changes by readjusting the sequence of activities, duration of time, or resources utilizing available float.

1. A change is major if, in the opinion of the Engineer, the change affects the substantial completion date or other contractual and milestone dates.

2. Minor changes are those that only affect activities with adequate float time.

F. Once the schedule is reviewed by the Engineer, the Contractor shall submit 6 sets of the revised schedule within 14 calendar days.

G. Throughout the duration of the project, the Engineer may require more detailed breakdowns of activities, logic, and schedule submittals from the Contractor.

H. Updated Schedules: Submit at monthly intervals or as directed by the Engineer. The schedule shall reflect all changes occurring since the last update including the following:

1. Activities started and completed during the previous period.

2. The estimated duration to complete each activity that was started but not completed.

3. Percentage of cost payable for each activity.

4. Modifications and pending proposed changes.

5. Narrative report describing current and anticipated problem areas or delaying factors with their impact together with an explanation of corrective actions taken or proposed.

I. Failure on the part of the Contractor to submit updated schedules may be grounds for the Engineer to withhold progress payments for items noted on the schedule.

J. Contractor shall prosecute the work according to the CPM Schedule. The Engineer shall rely on the reviewed Contractor's CPM Schedule and regular updates for planning and coordination. The Engineer's review of the Contractor's CPM Construction Schedule does not relieve the Contractor of its obligation to complete the work within the allotted contract time. Nor does the review grant, reject or in any other way act on the Contractor's request for adjustments to complete remaining contract work, or for claims of additional compensation. These requests shall be processed in accordance with other relevant provisions of the contract.

K. If the Engineer issues a field order or change order or other directive that affects the sequence or duration of work activities noted on the construction progress schedule, the Contractor shall promptly update the schedule. To accomplish this update, add, delete or revise the work activities noted or change the logic in the schedule to show the Contractor's plan to incorporate the change into the flow of work. All change orders and time extension requests that affect the construction schedule shall be evaluated based on their impact on the approved Construction Schedule.

L. If the current work is behind schedule or projected to be behind schedule, such as negative float on a critical activity or inability to meet the Contract Completion Date, the Engineer may require the Contractor, at the Contractor's cost, to take remedial measures to get the project back on schedule. This may require increasing the work force, working overtime and weekends, air freighting materials, or other similar actions.

M. If at any time the Engineer determines that any critical activity has fallen behind the CPM schedule by 15 calendar days or more, the Contractor shall submit a remedial plan to recapture the lost scheduled time. Include a revised schedule. Furnish the remedial plan no later than 7 calendar days from Engineer's notification.

N. If an accelerated schedule is proposed, refer to GENERAL CONDITIONS Section 7.22 "CONSTRUCTION SCHEDULE" section.

2.03 SCHEDULE OF PRICES

A. Furnish a schedule of prices per Engineer.

B. Provide a breakdown of the Contract Sum in enough detail to facilitate developing and the continued evaluation of Payment Applications. Provide several line items for principal subcontract amounts, or for materials or equipment purchased or fabricated and stored, but not yet installed, where appropriate. Round amounts to nearest whole dollar; total shall equal the Contract Price.

C. Each item in the Schedule of Prices and Payment Application shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

2.04 PAYMENT APPLICATION

A. Use the Schedule of Prices to produce the Payment Application and Construction Progress Report. Each Payment Application shall be consistent with previous applications and payments. The Engineer shall determine the appropriateness of each payment application item.

B. Payment Application Times: The date for each progress payment is the last day of each month. The period covered by each Payment Application starts on the first day of the month or following the end of the preceding period and ends on the last day of the month.

C. Updating: Update the schedule of prices listed in the Payment application when Change Orders or Contract Modifications result in a change in the Contract Price.

D. Provide a separate line item for each part of the Work where Payment Application may include materials or equipment purchased or fabricated and stored, but not yet installed.

E. Differentiate between items stored on-site and items stored off-site. Include evidence of insurance or bonded warehousing if required.

F. Provide separate line items for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.

G. Application Preparation: Complete every entry on form. Execute by a person authorized to sign legal documents on behalf of the Contractor.
   1. Entries shall match data on the Schedule of Prices and Contractor's Construction Schedule. Use updated schedules if revisions were made. Include amounts of Change Orders and Contract Modifications issued before last day of construction period covered by application.

H. No payment will be made until the following are submitted each month:
   1. Monthly Estimate, 7 copies.
   2. Monthly Progress Report, 7 copies.
   3. Statement of Contract Time, 7 copies.
   4. Updated Submittal Register, one copy.
   5. Updated Progress Schedule, one copy.
   6. All Daily Reports, one copy.
   7. All Payroll Affidavits for work done, one copy.

I. Retainage: The Department will withhold retainage in compliance with the GENERAL CONDITIONS.

J. Transmittal: Submit the signed original and 6 copies of each Payment Application for processing. Send the payment application with a transmittal form.

2.05 CONTRACTOR DAILY PROGRESS REPORTS

A. The General Contractor and all Subcontractors shall keep a daily report of events.

B. The form of the Contractor Daily Progress Report shall be as directed by the Engineer.

C. Submit copies of the previous week's reports on Monday morning by 10:00 a.m.

D. Submit copies of the reports with the monthly payment request for the entire period since the last payment request was made.

E. Deliver the reports in hard copy or e-mail as directed by the Engineer.

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01330 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.01 SUMMARY

A. Comply with the GENERAL CONDITIONS “Shop Drawings and Other Submittals” section and “Material Samples” section.

B. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other miscellaneous submittals.

C. Related Sections include the following:
   1. SECTION 01320 - CONSTRUCTION PROGRESS DOCUMENTATION for submitting schedules and reports, including Contractor’s Construction Schedule and the Submittals Schedule.

   2. SECTION 01770 - CLOSEOUT PROCEDURES for submitting warranties, project record documents and operation and maintenance manuals.

1.02 SUBMITTAL PROCEDURES

A. Coordinate Work and Submittals: Contractor shall certify the submittals were reviewed and coordinated.

B. Submittal Certification: Provide a reproduction (or stamp) of the “Submittal Certification” and furnish the required information with all submittals. Include the certification on:
   1. The title sheet of each shop drawing, or on

   2. The cover sheet of submittals in 8-1/2-inch x 11-inch format, or on

   3. One face of a cardstock tag (minimum size 3-inch x 6-inch) tied to each sample. On the sample tag, identify the sample to insure sample can be matched to the tag if accidentally separated. The opposite face of the tag will be used by the Engineer to receive, review, log stamp and include comments.

C. Variances: The Contractor shall request approval for a variance. Clearly note any proposed deviations or variances from the Specifications, Drawings, and other Contract Documents on the submittal and also in a separately written letter accompanying the submittal.

D. Submittal Certification Form (stamp or digital):

CONTRACTOR'S NAME: _____

PROJECT: _____

STATE JOB NO: _____

As the General Contractor, we checked this submittal and we certify it is correct, complete, and in compliance with Contract Drawings and Specifications. All affected Contractors and suppliers are aware of, and will integrate this submittal into their own work.

SUBMITTAL NUMBER _____ DATE RECEIVED _____

REVISION NUMBER _____ DATE RECEIVED _____

SPECIFICATION SECTION NUMBER /PARAGRAPH NUMBER _____

DRAWING NUMBER _____

SUBCONTRACTOR'S NAME _____

SUPPLIER'S NAME _____

MANUFACTURER'S NAME _____

NOTE: DEVIATIONS FROM THE CONTRACT DOCUMENTS ARE PROPOSED AS FOLLOWS (Indicate "NONE" if there are no deviations)

_____

_____

_____

CERTIFIED BY	

Note: Form can be combined with Design Consultant's Review stamp. This is available from the Engineer.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 SUBMITTAL REGISTER AND TRANSMITTAL FORM

A. Contractor shall use submittal register and transmittal forms as directed by the Engineer.

B. The listing of required submittals within this Section is provided for the Contractor's convenience. Review the specification technical sections and prepare a comprehensive listing of required submittals. Furnish submittals to the Engineer for review.

C. Contractor shall separate each submittal item by listing all submittals in the following groups with the items in each group sequentially listed by the specification section they come from:
   1. Administrative.

   2. Data.

3. Tests.

4. Closing.

D. Contractor shall separate all different types of data as separate line items all with the column requirements.

E. Contractor shall send monthly updates and reconciled copies electronically to the Engineer and the Design Consultant in MS Word or MS Excel or other format as accepted by the Engineer.

Section No. – Title	Shop Drawings & Diagrams	Samples	Certificates (Material, Treatment, Applicator, etc.)	Product Data, Manufacturer's Technical Literature	MSDS Sheets	Calculations	Reports (Testing, Maintenance, Inspection, etc.)	Test Plan	O & M Manual	Equipment or Fixture Listing	Schedules (Project Installation)	Maintenance Service Contract	Field Posted As-Built Drawings	Others	Guaranty or Warranty	Manufacturer's Guaranty or Warranty (Greater than one year)
01310 - Project Management and Coordination	■										■			■		
01320 - Construction Progress Documentation											■			■		
01330 - Submittal Procedures			■													
01500 - Temporary Facilities and Controls							■									
01700 - Execution Requirements														■		
01770 - Closeout Procedures														■	■	
03300 - Concrete				■												
16011 - General Electrical Requirements			■				■						■		■	
16100 - Electrical Work	■			■			■									
16208 - Engine Generator Set	■			■			■		■			■		■	■	
16262 - Automatic Transfer Switches	■		■						■			■		■	■	
16301 - Underground Electrical Work			■	■			■									

END OF SECTION

SECTION 01500 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.01 SUMMARY

A. Requirements for temporary facilities and controls, including temporary utilities, support facilities, and security and protection facilities.

B. Temporary utilities include but are not limited to, the following:
   1. Sanitary facilities, including toilets, wash facilities, and drinking water facilities.
   2. Electric power service.
   3. Lighting.
   4. Telephone service.

C. Support facilities include, but are not limited to, the following:
   1. Storage and fabrication sheds.
   2. Trash, refuse disposal.
   3. Erosion controls and site drainage.
   4. Construction aids and miscellaneous services and facilities.

D. Security and protection facilities and measures include, but are not limited to, the following:
   1. Environmental protection.
   2. Stormwater control.
   3. Tree and plant protection.
   4. Site enclosure fence.
   5. Barricades, warning signs, and lights.

E. Related Sections: Refer to DIVISIONS 2 through 16 for other temporary requirements and products in those Sections.

1.02 USE CHARGES

A. General: Cost or use charges for temporary facilities are not chargeable to the State and shall be included in the Contract Price. Allow other entities to use temporary services and facilities without cost, including, but not limited to, the following:
   1. Other Contractors with agreements with the State working within the contract limits.

2. Occupants of Project.

3. Testing agencies.

4. Engineer and personnel of authorities having jurisdiction.

1.03 SUBMITTALS

A. Submit in accordance with SECTION 01330 - SUBMITTAL PROCEDURES.

B. Temporary Utility Reports: Submit reports of tests, inspections, meter readings, and similar procedures performed on temporary utilities.

C. Landfill Disposal Receipts: Submit copies of receipts issued by a landfill facility. Include receipts with Contractor Daily Progress Report.

1.04 QUALITY ASSURANCE

A. Standards: Comply with UBC Chapter 33, “Site Work, Demolition and Construction”, ANSI A10.6, NECA’s “Temporary Electrical Facilities”, and NFPA 241, "Construction, Alteration, and Demolition Operations".
   1. Trade Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with trade regulations and union jurisdictions.

   2. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70, “National Electrical Code”.
      a. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

B. Provide accessibility around temporary structures conforming to ADAAG Section 201.3 and 206.1.

1.05 PROJECT CONDITIONS

A. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:
   1. Keep temporary services and facilities clean and neat.

   2. Relocate temporary services and facilities as required by progress of the Work.

1.06 PREPARATION AND PROTECTION

A. Protection of Property: Continually maintain adequate protection of the Work from damage and protect all property, including but not limited to buildings, equipment, furniture, grounds, vegetation, material, utility systems located at and adjoining the job site. Repair, replace or pay the expense to repair damages resulting from Contractor’s fault or negligence.

B. Before starting work to be applied to previously erected constructions, make a thorough and complete investigation of the recipient surfaces and determine their suitability to receive required additional construction and finishes. Make any

repair that is required to properly prepare surfaces and coordinate the Work to provide a suitable surface to receive following Work.

C. Commencing work by any trade implies acceptance of existing conditions and surfaces as satisfactory for the application of subsequent work, and full responsibility for finished results and assumption of warranty obligations under the Contract.

D. Protect existing (including interiors) work to prevent damage by vandals or the elements. Provide temporary protection. Use curtains, barricades, or other appropriate methods. Take positive measures to prevent breakage of glass and damage to plastic, aluminum and other finishes.

E. Repairs and Replacements: Promptly replace and repair damages to the approval of the Engineer. Additional time required to secure replacements and to make repairs does not justify a time extension.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General: Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Engineer. Provide materials suitable for use intended.

B. Plastic Enclosure Fence: Industry standard 4-feet high plastic fencing with metal (or wood) post supports at 10-feet on center connected with a top and bottom 12-gauge soft annealed galvanized tie wires securely connected to posts. Posts shall be capable of resisting a lateral load of 100 pounds measured at the top of the post.

2.02 EQUIPMENT

A. Drinking Water Fixtures: Drinking water fountains or containerized, tap dispenser, bottled water drinking water units, or water cooler dispensing water at 45 to 55 degrees F available at including paper cup supply.

B. Electrical Outlets: Properly configured, NEMA polarized outlets to prevent insertion of 110 to 120V plugs into higher voltage outlets; equipped with ground fault circuit interrupters, reset button, and pilot light.

C. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125V ac, 20 A rating, and lighting circuits may be nonmetallic sheathed cable.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.

B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.02 TEMPORARY UTILITY INSTALLATION

A. General: Connect to existing service where directed by the Engineer:
   1. Arrange with the State and existing water users for time when service can be interrupted, if necessary, to make connections for temporary services.

   2. Provide adequate capacity at each stage of construction.

B. Water Service: A temporary tap into the facility's existing water system is allowed, subject to the following conditions:
   1. Comply with the Department of Health's and County water provider's requirements when tapping into the existing water system.

   2. Reasonable amounts of water will be available without charge.

   3. Should the Contractor at any time fail to comply with any or all of the above conditions, the Engineer may terminate the use of water. The Contractor shall remove the hookup within 48 hours of notification of such termination.

C. Sanitary Facilities: Use of user's existing toilet facilities will be permitted where and when directed by the Engineer, as long as facilities are cleaned and maintained in a condition acceptable to user. At Substantial Completion, restore these facilities to condition existing before initial use.

D. Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload protected disconnecting means, automatic ground fault interrupters, and main distribution switchgear. Use of State facilities electrical power services will be permitted as long as equipment is maintained in a condition acceptable to the Engineer.

E. Electric Distribution: Provide receptacle outlets adequate for connection of power tools and equipment. Protect wiring, in conduits or other, measures when exposed to possible damage or traffic areas.

F. Lighting: Provide temporary lighting with local switching that provides adequate illumination for traffic conditions.

G. Telephone Service: Provide a portable wireless telephone with voice-mail or messaging service for superintendent's use in making and receiving telephone calls when at the construction site.

3.03 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:
   1. Locate storage sheds and other temporary construction and support facilities for easy access or where shown on Contract Drawings or as directed by the Engineer.

2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion.

B. Traffic Controls: Provide temporary traffic controls at junction of temporary roads with public roads. Include warning signs for public traffic and "STOP" signs for entrance onto public roads. Comply with requirements of authorities having jurisdiction.

C. Temporary Sign(s):
   1. Provide and install signs as listed. Sign designs are attached to PART 3 of this Section:
      a. Warning Sign

   2. Install signs where directed by the Engineer or where indicated to inform public and persons seeking entrance to the Project. Do not permit installation of unauthorized signs.

   3. Provide temporary signs to provide directional information to constructional personnel and visitors.

   4. Construct signs with durable materials, properly supported or mounted, and visible.

D. Trash, Refuse Disposal:
   1. Department of Health - Illegal Dumping Notice: See attachment to PART 3 of this section.
      a. This Notice to be printed out on 8.5x11" paper.

      b. This Notice to be posted at the job site field office and/or in locations visible to all contractors, subcontractors, suppliers, vendors, etc. throughout the duration of the project.

   2. Illegal Dumping of solid waste could subject the Contractor to fines and could lead to felony prosecution in accordance with Chapter 342H, HRS. For more information, see the following web site: http://www.hawaii.gov/health/environmental/waste/sw/pdf/Illdump.pdf

   3. Provide waste collection containers in sizes adequate to handle waste from construction operations. Containerize and clearly label hazardous, dangerous, or unsanitary waste materials separately from other waste.

   4. Do not burn debris or waste materials on the project site.

   5. Do not bury debris or waste material on the project site unless specifically allowed elsewhere in these specifications as backfill material.

   6. Haul unusable debris and waste material to an appropriate offsite dump area.
      a. Water down debris and waste materials during loading operations or provide other measures to prevent dust or other airborne contaminants.

      b. Damp sweep when cleaning rubbish and fines which can become airborne from floors or other paved areas. Do not dry sweep.

7. Clean up shall include the collection of all waste paper and wrapping materials, cans, bottles, construction waste materials and other objectionable materials, and removal as required. Frequency of clean up shall coincide with rubbish producing events.

3.04 ENVIRONMENTAL CONTROLS

A. General: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

B. Dust Control:
   1. Prevent dust from becoming airborne at all times including non-working hours, weekends and holidays in conformance with the State Department of Health, Administrative Rules, Title 11, Chapter 60.1, Air Pollution Control.

   2. Contractor is responsible for and shall determine the method of dust control. Subject to the Contractor's choice, the use of water or environmentally friendly chemicals may be used over surfaces that create airborne dust.

   3. Contractor is responsible for all damage claims due to their negligence to control dust.

C. Noise Control:
   1. Keep noise within acceptable levels at all times in conformance with the State Department of Health, Administrative Rules, Title 11, Chapter 46, Community Noise Control. Obtain and pay for the Community Noise Permit when construction equipment or other devices emit noise levels exceeding the allowable limits.

   2. Ensure mufflers and other devices are provided on equipment, internal combustion engines and compressors to reduce loud disruptive noise levels and maintain equipment to reduce noise to acceptable levels.

   3. Unless specified elsewhere, do not start construction equipment that meets allowable noise limits prior to 6:45 a.m. or equipment exceeding allowable noise levels prior to 7:00 a.m.

   4. Compliance with the provisions of this section by the subcontractors will be the responsibility of the Contractor.

D. Erosion Control:
   1. During grading and earthwork operations, maintain the grade to prevent damage to adjoining property from water and eroding soil.

   2. Install temporary silt fences, cut off ditches and other provisions needed for construction methods and operations. Should there be a question if the temporary measures are insufficient to prevent erosion, the Engineer shall make the final determination.

3. Construct and maintain drainage outlets and silting basins where shown on the Drawings and when required to minimize erosion and pollution of waterways during construction.

E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from construction damage. Protect existing landscaping and tree root systems from damage, flooding, and erosion due to construction activity.

3.05 VIOLATION OF ENVIRONMENTAL PROVISIONS

A. Violations of any of the above environmental control requirements or any other pollution control requirements; which may also be specified in the other Specifications sections, shall be resolved under the SUSPENSION and CORRECTIVE WORK Section of the GENERAL CONDITIONS.

3.06 BARRICADES AND ENCLOSURES

A. Barricades: Before construction operations begin, erect temporary construction barricade(s) to prevent unauthorized persons from entering the project area and to the extent required by the Engineer.
   1. Maintain temporary construction barricade(s) throughout the duration of the Work. During the course of the project, the Engineer may require additional barricades be provided for the safety of the public. Contractor shall erect the additional barricade(s) at its own expense.

   2. Construction: Plastic fencing

B. Security Enclosure and Lockup:
   1. Install substantial temporary enclosure around partially completed areas of construction.

   2. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft and similar violations of security.

C. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities.

3.07 OPERATION, TERMINATION, AND REMOVAL

A. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage caused by heat temperatures and similar elements.

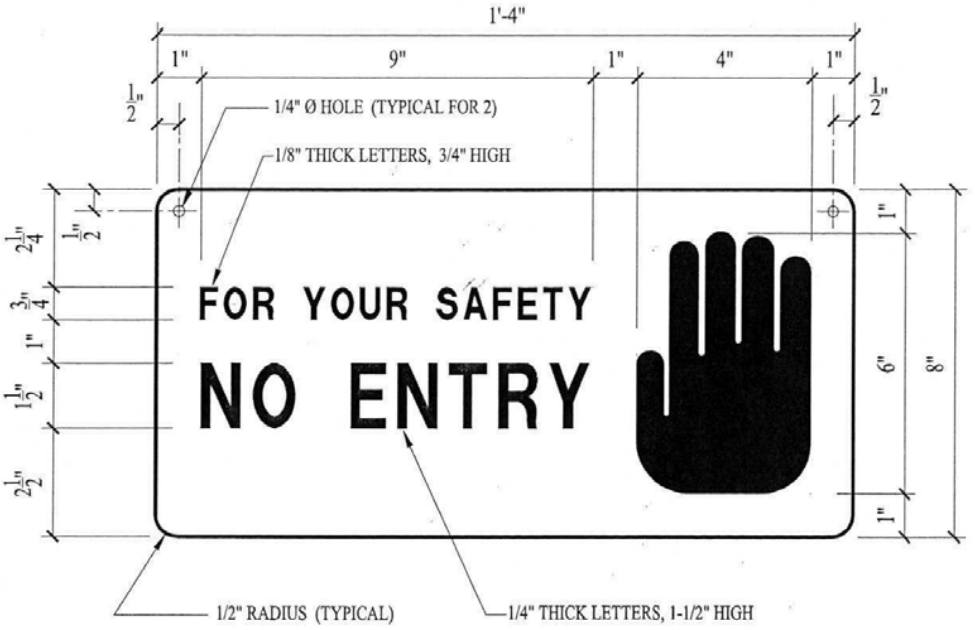
B. Termination and Removal: Remove each temporary facility when need for its service has ended, or when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
   1. Materials and facilities that constitute temporary facilities are the property of Contractor. The Department reserves the right to take possession of Project identification signs.

3.08 ATTACHMENTS

A. Warning Sign: Requirements for Warning Sign.

B. Department of Health - Illegal Dumping Notice.

REQUIREMENTS FOR WARNING SIGN



1. General Requirements: Furnish all labor, materials and equipment necessary to construct and in- stall warning signs as specified hereinafter.
2. Materials
    a. Backing: Backing shall be 6061-T6 aluminum 0.032-inch minimum thickness.
    b. Paint: Paint shall be satin finish, exterior grade or factory baked enamel or a combination thereof.
3. Colors: Signs shall have white background. Remaining items shall be similar to Rust-Oleum Federal Safety Red.
4. Requirements for Warning Sign: Message configuration and dimensions shall be in accordance with the attached illustration.
5. Installation
    a. Signs shall be located at 50-foot intervals around roped off work area or at all entrances in the case of interior work.
    b. Signs shall be attached to the rope barrier, rope barrier supports, individual sign supports or buildings. Do not use nails to attach signs to building(s).
6. Clean-up: Remove all signs upon completion of project. Repair any damages caused by sign mounting and removal.

DEPARTMENT OF HEALTH
ILLEGAL DUMPING NOTICE

The law requires you to dispose solid waste only at recycling or disposal facilities permitted by the Department of Health.

"Solid waste" includes municipal refuse, construction and demolition waste, household waste, tires, car batteries, derelict vehicles, green wastes, furniture, and appliances.

Illegal dumping of solid waste or allowing illegal disposal of solid waste on your property even if contractual or other arrangements are made could subject you to fines from $10,000 to $25,000 per occurrence and could lead to felony prosecution in accordance with Chapter 342H, HRS.

Contact the Department of Health, Solid Waste Section at 586-4226 to report illegal dumping activities or if you have further questions.

END OF SECTION

SECTION 01700 - EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
   1. Construction layout.
   2. Field engineering.
   3. General installation of products.
   4. Progress cleaning.
   5. Protection of installed construction.
   6. Correction of the Work.

B. Related Sections: SECTION 01770 - CLOSEOUT PROCEDURES.

1.02 SUBMITTALS

A. Submit in accordance with SECTION 01330 - SUBMITTAL PROCEDURES.

B. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.03 NOTIFICATION

A. Contact the Engineer at least 3 working days prior to starting any onsite work.

1.04 PROJECT AND SITE CONDITIONS

A. Project Contract Limits (Contract Zone Limits) indicate only in general the limits of the work involved. Perform necessary and incidental work, which may fall outside of these demarcation lines. Confine construction activities within the Project Contract Limits and do not spread equipment and materials indiscriminately about the area.

B. Disruption of Utility Services: Pre-arrange work related to the temporary disconnection of electrical and other utility systems with the Engineer. Unless a longer notification period is required elsewhere in the Contract Documents, notify the Engineer at least 15 days in advance of any interruption of existing utility service. Time and duration of interruptions are subject to the Engineer's approval. Keep the utility interruptions and duration to a minimum so as not to cause inconvenience or hardship to the facility. If temporary electrical or other utility systems hook-up is required, provide the necessary services. Pay for temporary services as part of the contract, unless specifically noted otherwise.

C. Contractor's Operations: Provide means and methods to execute the Work and minimize interruption or interference to the facility's operations. Rearrange the construction schedule when construction activities result in interruptions that hamper the operations of the facilities.

D. Maintain safe passageway to and from the facility's occupied buildings and other occupied spaces for the using agency personnel and the public at all times.

E. Contractor, Subcontractor(s) and their employees will not be allowed to park in zones assigned to Users or facility personnel. Subject to availability, the Engineer may designate areas outside of the Contract Zone Limits to be used by the Contractor. Restore any lawn area damaged by construction activities.

1.05 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor with a license to practice in Hawaii.

B. Professional Engineer Qualifications: A professional engineer with a license to practice in Hawaii.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 EXAMINING THE SITE

A. Contractor and Subcontractors are expected to visit the site and make due allowances for difficulties and contingencies to be encountered. Compare contract documents with work in place. Become familiar, with existing conditions, the conditions to be encountered in performing the Work, and the requirements of the drawings and specifications.

B. Verify construction lines, grades, dimensions and elevations indicated on the drawings before any construction begins. Bring any discrepancy to the attention of the Engineer and make any change in accordance with the Engineer instruction.

C. Obtain all field measurements required for the accurate fabrication and installation of the Work included in this Contract. Verify governing dimensions and examine adjoining work on which the Contractor or Subcontractor's work is in any way dependent. Submit differences discovered during the verification work to the Engineer for interpretations before proceeding with the associated work. Exact measurements are the Contractor's responsibility.

D. Furnish or obtain templates, patterns, and setting instructions as required for the installation of all Work. Verify dimensions in the field.

E. Contractor shall accept the site and the existing building(s) in the condition that exists at the time access is granted to begin the Work. Verify existing conditions and dimensions shown and other dimensions not indicated but necessary to accomplish the Work.

F. Locate all general reference points and take action to prevent their destruction. Lay out work and be responsible for lines, elevations and measurements and the work executed. Exercise precautions to verify figures and conditions shown on drawings before layout of work.

3.02 SITE UTILITIES AND TONING

A. Cooperate, coordinate and schedule work to maintain construction progress, and accommodate the operations and work of the owners of underground or overhead utility lines or other property in removing or altering the lines or providing new services.

B. Contact all the various utility companies before the start of the work to ascertain any existing utilities and to develop a full understanding of the utility requirements with respect to this Project. Furnish the Engineer with evidence that the utility companies were contacted.

C. Should the Contractor discover the existence and location of utilities in the contract drawings are not correct, do not disturb the utilities and immediately notify the Engineer.

D. Do not disturb or modify any utilities encountered, whether shown or not on the Contract Drawings, unless otherwise instructed in the drawings and specifications or as directed by the Engineer. Repair and restore to pre-damaged condition any utilities or any other property damaged by construction activities.

E. Transfer to “Field Posted As-Built” drawings the location(s) and depth(s) of new and existing utilities that differ from the Contract Drawings. Locate by azimuth and distance and depth(s) from fixed reference points.

F. Toning: Prior to the start of grading, or excavation or trenching work verify and confirm the presence, location and depth of existing underground utility lines in the area affected by the project by “toning” of by other appropriate means acceptable to the Engineer. The intent of this advanced toning is to afford the Engineer an opportunity to identify utility lines that may or may not be shown on the drawings and issue a directive to address the existing conditions.
   1. Perform toning using instruments specifically developed and designed for the detection of underground pipes and cable utilities.

   2. Notify the Engineer 48 hours in advance before toning operations. Provide information on the proposed toning method and other pertinent information.

G. Recording Toning Information: Upon completion of the toning operation, submit drawings that show the location and approximate depth of the existing and newly discovered utility lines. Identify the type of utility lines. Also, identify where utility lines indicated on the drawings are not shown in their approximate location of where new utility lines are found or pointed out in the field.

H. After ascertaining the exact location and depth of utilities within the project area, mark and protect the locations.

1. Acquaint personnel working near utilities with the type, size, location, depth of the utilities, and the consequences that might result from disturbances.

2. Do not start trenching or start similar operations until reasonable and appropriate precautions to protect the utilities are taken.

I. For newly identified utility lines, if directed by the Engineer, manually excavate within 2-feet of the utility line to avoid damage. Under this directive, manual excavation is considered additional work.

3.03 FIELD MEASUREMENTS:

A. Take field measurements to fit and install the Work properly. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress.

B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

C. Review of Contract Documents and Field Conditions: Submit a Request for Information (RFI) immediately upon discovery of the need for clarification of the Contract Documents. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.04 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to existing conditions. If discrepancies are discovered, notify the Engineer promptly.

B. General: Engage a licensed land surveyor to lay out the Work using accepted surveying practices.
   1. Establish benchmarks, control points, lines and levels as needed to locate each element of Project.

   2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required clearances.

   3. Inform installers of lines and levels to which they must comply.

   4. Check the location, level and plumb of every major event as the Work progresses.

   5. Notify the Engineer when deviations from required lines and levels exceed allowable tolerances.

   6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes and invert elevations.

D. Locate and lay out control lines and levels for equipment pads. Transfer survey markings and elevations for use with control lines and levels. Level the foundations from 2 or more locations.

E. Record Log: Maintain a log of control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by the Engineer.

3.05 FIELD ENGINEERING

A. Reference Points: Locate existing permanent or temporary benchmarks, control points and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
   1. Do not change or relocate existing benchmarks or control points without the Engineer's approval. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to the Engineer before proceeding.

   2. Replace lost of destroyed permanent benchmarks and control points promptly. Base all replacements on the original survey control points.

B. Benchmarks: Establish and maintain a minimum of 2 permanent or temporary benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
   1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

   2. Where the actual location or elevations of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.

   3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3.06 INSTALLATION

A. Install materials, items, fixtures required by the various Divisions and Sections of the Specifications in accordance with Contract Documents, by workers specially trained and skilled in performance of the particular type of work, to meet guarantee and regulatory agency requirements. Should the drawings or specifications be void of installation requirements, install the materials, items, and fixtures in accordance with the manufacturer's current specifications, recommendations, instructions and directions.

3.07 CUTTING AND PATCHING

A. Oversee cutting and patching of concrete, masonry, structural members and other materials where indicated on drawings and as required by job conditions. Unless noted elsewhere in the Drawings and Specifications, do not cut or patch existing or new structural members without previously notifying the Engineer.

B. Provide patch materials and workmanship of equal quality to that indicated on the drawings or specified for new work.

3.08 CLEANING

A. General: Clean the Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
   1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.

   2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 degrees F.

   3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
   1. Remove liquid spills promptly.

   2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use only cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

F. Cutting and Patching: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.09 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.10 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions to provide proper temperature and relative humidity conditions.

3.11 CORRECTION OF THE WORK

A. Repair or replace defective construction. Restore damaged substrates and finishes.
   1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair defective components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION

SECTION 01770 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including the following:
   1. Project Record Documents.
   2. Operation and Maintenance Manuals.
   3. Warranties.
   4. Instruction for the State's personnel.

B. Related Documents: SECTION 01700 - EXECUTION REQUIREMENTS.

1.02 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting a Final Inspection to determine Substantial Completion, complete the following items in addition to requirements of ARTICLE 7 of the GENERAL CONDITIONS.
   1. Advise the Engineer of pending insurance changeover requirements.
   2. Submit specific warranties, final certifications, and similar documents.
   3. Arrange to deliver tools, spare parts, extra materials, and similar items to a location designated by the Engineer. Label with manufacturer's name and model number where applicable.
   4. Make final changeover of permanent locks and deliver keys to the Engineer. Advise the State's personnel of changeover in security provisions.
   5. Complete startup testing of systems.
   6. Submit test records.
   7. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
   8. Complete final cleaning requirements, including touch up painting.
   9. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
   10. Submit the O&M Manual(s) for review.
   11. Submit Field-Posted As-Builts.

1.03 FINAL COMPLETION

A. Preliminary Procedures: Within 10 days from the Project Acceptance Date, complete the following items in addition to requirements of GENERAL CONDITIONS, Article 7 - PROSECUTION AND PROGRESS:
   1. Instruct the State's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training media materials.

1.04 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit 2 copies of any updated and action taken list. In addition to requirements of GENERAL CONDITIONS Article 7 PROSECUTION AND PROGRESS, include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
   1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.

   2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.

   3. Include the following information at the top of each page:
      a. Project Name and Title.

      b. Job No.

      c. Date and page number.

      d. Name of Contractor.

1.05 PROJECT RECORD DOCUMENTS AND REQUIREMENTS

A. General:
   1. Definition: "Project Record Documents", including Record Drawings, shall fulfill the requirements of "Field-Posted As-Built Drawings" listed in the GENERAL CONDITIONS.

   2. Do not use Project Record Documents for daily construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Engineer's reference during normal working hours. Maintain these documents as specified in paragraph entitled "Record Drawings" hereinafter.

   3. The Designer, under contract with the State, will update the drawings to show all addendum, PCD, and sketch changes. The Engineer will transmit these drawings (mylar or vellum) to the Contractor who will make all "red-line" corrections to these drawings to record the changes depicted on the Contractor's Field Posted Record ("As-Builts") by accepted drafting practices as approved by the Engineer.

4. Where the recorded changes depicted on the Contractor's Field Posted Record ("As-Builts") are in the form of shop drawings, the Contractor shall provide those shop drawings on mylar or vellum sheets in the same material and size as the drawings transmitted to the Contractor. The new drawing sheets shall be titled and numbered to conform to the construction drawings and clearly indicate what information they supersede in the actual construction drawings. For example, a new drawing that replaces Drawing M-3, could be numbered M3a.

5. The Contractor shall bring to the attention of the Engineer any discrepancy between the changes made by the Designer and those depicted on addendum, PCD, and sketch changes. The Engineer will resolve any conflicts.

6. Submit final Record Documents (Field Posted Record Drawings) within 10 days after the Final Inspection Date but no later than the Contract Completion Date, unless the GENERAL CONDITIONS require an earlier submittal date.

7. The Contractor shall guarantee the accuracy of its final Record Documents. The State will hold the Contractor liable for costs the State incurs as a result of inaccuracies in the Contractor's Record Documents.

8. Prepare and submit construction photographs and electronic files, damage or settlement surveys, property surveys, and similar final record information as required by the Engineer.

9. Deliver tools, spare parts, extra materials, and similar items to a location designated by the Engineer. Label with manufacturer's name and model number where applicable.

10. Submit Final, corrected O&M Manual(s).

B. Record Drawings:
   1. Maintain a duplicate full-size set of Field Posted Record ("As-Builts") Drawings at the job site. Clearly and accurately record all deviations from alignments, elevations and dimensions, which are stipulated on the drawings and for changes directed by the Engineer that deviate from the drawings.

   2. Record changes immediately after they are constructed in place and where applicable, refer to the authorizing document (Field Order, Change Order, or Contract Modification). Use red pencil to record changes. Make Field Posted Record Drawings available to the Engineer at any time so that its clarity and accuracy can be monitored.
      a. Give particular attention to information on concealed elements that cannot be readily identified and recorded later.

      b. Accurately record information in an understandable drawing technique.

      c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

d. Mark the contract drawings or the shop drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on contract drawings.

e. Mark important additional information that was either shown schematically or omitted from original Drawings.

f. Locate concealed building utilities by dimension from bench marks or permanent structures. Locate site utilities by dimensions, azimuth and lengths from bench marks or permanent structures.

g. Note field order numbers, Change Order numbers, Contract Modification numbers, Alternate numbers, post-construction drawing numbers (PCD) and similar identification (RFI numbers) where applicable.

h. The Contractor shall initial each deviation and each revision marking.

3. Use the final updated Contract Drawing set plus applicable shop drawings for making the final Field Posted Record Drawings submittal.

4. Certify drawing accuracy and completeness. Label and sign the record drawings or use digital electronic signature as approved by the Engineer.

5. Label the title sheet and on all sheets in the margin space to the right of the sheet number, written from the bottom upward, with the title "FIELD POSTED RECORD DRAWINGS" and certification information as shown below. Provide a signature line and company name line for each subcontractor that will also certify the respective drawing. Adjust size to fit margin space.

   FIELD POSTED RECORD DRAWINGS Certified By: _____ Date: _____
   [Contractor's Company Name]

6. Revise the Drawing Index and label the set "FIELD POSTED RECORD DRAWINGS". Include the label "A COMPLETE SET CONTAINS [_____] SHEETS" in the margin at the bottom right corner of each sheet. Quantify the total number of sheets comprising the set.

7. If the Engineer determines a drawing does not accurately record a deviation or omits relevant information, the State will correct any FIELD POSTED RECORD DRAWINGS sheet. Contractor will be charged for the State's cost to correct the error or omission.

8. Use the final Field Posted Record Drawings sheets to create one electronic version of the set. The set shall be recorded in Adobe Acrobat PDF (Portable Document Format). Create a single indexed, bookmarked PDF file of the entire set of drawings and record on the CD. Submit one set of the final Field Posted Record Drawings sheets and the complete electronic CD set(s).

1.06 WARRANTIES

A. Submittal Time: Submit written manufacturer's warranties at request of the Engineer for designated portions of the Work where commencement of warranties other than Project Acceptance date is indicated.

B. Partial Occupancy: Submit properly executed manufacturer's warranties within 45 days of completion of designated portions of the Work that are completed and occupied or used by the State during construction period by separate agreement with Contractor.

C. Organize manufacturer's warranty documents into an orderly sequence based on the table of contents of the Specifications.
   1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-inch x 11-inch paper.

   2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer and prime contractor.

   3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES", Project Name and Title, State Job Number, and name of Contractor.

   4. Use the final submittal of the warranties to create an electronic Adobe Acrobat PDF (Portable Document Format) version of the bound warranty documents files. Each sheet shall be separately scanned, at 600 DPI or better into a PDF file, indexed and recorded on a recordable compact disc (CD).

D. Provide 2 sets of manufacturer's warranties that exceed one year and one CD as part of the closing document submittals. Provide additional copies of each warranty to include in operation and maintenance manuals.

1.07 OPERATION AND MAINTENANCE MANUALS

A. Assemble complete sets of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:
   1. Operation Data:
      a. Emergency instructions and procedures.

      b. System, subsystem, and equipment descriptions, including operating standards.

      c. Operating procedures, including startup, shutdown, seasonal, and weekend operations.

      d. Description of controls and sequence of operations.

e. Piping diagrams.

2. Maintenance Data:
   a. Manufacturer's information, Material Safety Data Sheets, and a list of spare parts.

   b. Name, address, and telephone number of installer or supplier.

   c. Maintenance procedures.

   d. Maintenance and service schedules for preventive and routine maintenance.

   e. Maintenance record forms.

   f. Sources of spare parts and maintenance materials.

   g. Copies of maintenance service agreements.

   h. Copies of warranties and bonds.

B. Use the following 3 paragraph headings, "Notes, Cautions and Warnings", to emphasize important and critical instructions and procedures. Place the words "Notes", "Cautions", or "Warnings" immediately before the applicable instructions or procedures. Notes, Cautions and Warnings are defined as follows:
   1. Note: highlights an essential operating or maintenance procedure, condition or statement.

   2. Caution: highlights an operating or maintenance procedure, practice, condition or statement which if not strictly observed, could result in damage to or destruction of equipment, loss of designed effectiveness, or health hazards to personnel.

   3. Warning: highlights an operating or maintenance procedure, practice, condition, or statement that if not strictly observed, could result in injury to or death of personnel.

C. Organize the Operation and Maintenance Manuals into suitable sets of manageable size. Bind and index data in heavy-duty, "D" type 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with pocket inside the covers to receive folded oversized sheets. Binder color shall be maroon, or if not available red. Identify each binder on front and spine with the printed title "OPERATION AND MAINTENANCE MANUAL", Project Name and Title include building number when appropriate, Job Number, Prepared For*:* Department of Defense, State of Hawaii*,* Prepared By*:* [Contractor] and Volume Number. Each binder is a single volume.

D. Electronic Format:
   1. Provide all information (narratives, drawings and manual) on a Compact Disc (CD). Provide drawings and plans prepared for the O&M Manuals drawn electronically and saved as a PDF file. Name and index the files for ease of identification and updates.

2. Provide the complete O&M Manual using Adobe Acrobat PDF (Portable Document Format) files. Each sheet shall be separately scanned into a PDF file, indexed, bookmarked, hyperlinked to the table of contents and recorded on a compact disc (CD). Scanned documents shall be scanned at 600 DPI or better. Indexes and bookmarks may be highlighted or colored text. The final submittal shall include written instructions for installing, accessing and retrieving information from the compact disc.

E. Pre-Final Submittal: Submit 2 printed sets of Pre-Final Operation and Maintenance Manuals, for review by the Engineer, at least 5 days prior to scheduled final inspection. Manuals shall be marked as Pre-Final. Make any correction noted before submitting the final Operation and Maintenance Manuals.
   1. The user and the Department will each keep one copy of the Pre-Final submittal to operate and maintain the facility from the Project Acceptance Date through submission of the final submittal. Therefore, the submittal shall contain all the required information that is available at the time of submission.

   2. One set will be returned with comments. Additional review comments may include problems discovered during the O&M Manual's review, site validation, and facility start up and will be provided to the Contractor after facility Project Acceptance Date.

F. Final Submittal: Use the final submittal of the manuals to create the electronic PDF file version of the bound Operation and Maintenance Manuals documents. Include the Submittal (100 percent) review comments along with a response to each item. Provide one Final set of the printed manuals and 6 Final compact discs, (CDs) as part of the closing document submittal. Final printed manual and disks shall be marked as Final.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.01 DEMONSTRATION AND TRAINING

A. Instruction: Instruct the State's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
   1. Provide instructors experienced in operation and maintenance procedures.

   2. Provide instruction at mutually accepted times.

   3. Schedule training with the State's users, through the Engineer with at least 7 days advanced notice.

4. Coordinate instructors, including providing notification of dates, times, length of instruction, and course content.

B. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections. For each training module, develop a learning objective and teaching outline. Include instruction for the following:
   1. System design and operational philosophy.

   2. Review of documentation.

   3. Operations.

   4. Adjustments.

   5. Troubleshooting.

   6. Maintenance.

   7. Repair.

3.02 FINAL CLEANING

A. General: Provide final cleaning. In addition to requirements of Article 7 of the GENERAL CONDITIONS conduct cleaning and waste-removal operations to comply with local laws and ordinances and federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturers written instructions unless noted otherwise. Complete the following cleaning operations before requesting final inspection for entire Project or for a portion of Project:
   1. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.

   2. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits resulting from construction activities.

   3. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.

   4. Remove tools, construction equipment, machinery, and surplus material from Project site.

   5. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.

6. Remove debris and surface dust from limited access spaces, including: roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.

7. Sweep concrete floors broom clean in unoccupied spaces.

8. Remove labels that are not permanent.

9. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
   a. Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.

10. Replace parts subject to unusual operating conditions.

11. Leave Project clean and ready for occupancy.

C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the State's property. Do not discharge volatile, harmful, or dangerous materials into drainage and sewer systems or onto State property. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION

DIVISION 2 - SITE CONSTRUCTION

SECTION 02200 - CLEARING AND GRUBBING

PART 1 - GENERAL

1.01 SUMMARY

A. Furnish all labor, equipment and tools to complete the clearing and grubbing indicated on or required by the contract drawings and as specified herein.

1.02 GENERAL REQUIREMENTS

A. It shall be the responsibility of the Contractor to examine the site and determine for himself the existing conditions.

B. Obvious conditions of the site existing on the date of the bid opening shall be accepted as part of the work, even though they may not be clearly indicated on the drawings and/or described herein or may vary therefrom.

C. All debris of any kind accumulated from clearing shall be disposed of from the site, and the whole area left clean. The Contractor shall be required to make all necessary arrangements relative to the proposed place of disposal.

1.03 CLEARING AND GRUBBING

A. The Contractor shall clear off and remove the natural ground of vegetative material and obstructions interfering within the area to be improved. Vegetative materials include trees, stumps, large roots, buried logs, roots of downed trees, brush, grass and weeds. Obstructions include garbage and other unsuitable material.

1.04 REMOVAL AND DISPOSAL OF MATERIAL

A. The Contractor shall dispose the material removed as specified above at a suitable land disposal site acceptable to the Engineer. If the Contractor disposes the material outside the project area, the Contractor shall make arrangements and bear the costs involved in the disposal.

1.05 PROTECTION

A. Barricade: Erect temporary construction barricades.

B. Take all precautions and safety measures as required to protect the State of Hawaii free and harmless from liability of any kind. Conduct operations with minimum interference to streets, driveways, sidewalks, passages, etc.

C. Adequate precautions shall be taken before commencing and during the course of the work to ensure the protection of life, limb and property.

D. The Contractor shall exercise every precaution to preserve and protect all surrounding structures, landscaping, lawns, walkways, ties, pavements, utilities, and other improvements which are to remain or be relocated. Any damage shall be repaired or replaced by the Contractor to the satisfaction of the Engineer.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 CLEAN-UP AND DISPOSAL

A. From time to time and at the completion of the demolition and removal work, remove from the site all rubbish, debris, excess excavated material accumulated from this work and leave the area neat and clean to the satisfaction of the Engineer. Debris shall be removed and transported in a manner that will prevent spillage on the street or adjacent area.

END OF SECTION

SECTION 02920 - LAWNS AND GRASS

PART 1 - GENERAL

1.01 SUMMARY

A. Furnish all labor, materials, equipment and tools for grass planting as specified herein. Grass shall be planted in areas indicated on the contract drawings and as listed below:
   1. All existing grassed areas that are damaged by construction operations;

   2. Areas where the existing pavement is removed and will not be replaced.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Grass shall be Bermuda (Cynodon Dactylon). At the option of the Contractor, grass planting may be by seeds (plain seeding) or by sprigs.
   1. Grass seeds shall be fresh, hulled, and meet the following requirements:
      a. Pure Seed: 95.0 percent minimum

      b. Crop Seed: 1.0 percent maximum

      c. Weed: 0.5 percent maximum

      d. Inert Material: 5.0 percent maximum

      e. Germination: 85.0 percent minimum

      Grass seeds shall be delivered to the site in unopened, sealed containers, labeled with the brand name and per cent purity. Labeling shall indicate that the seeds passed a certified germination test no more than 12 months prior to use.

   2. Grass sprigs shall be healthy living runners and stolons, a minimum of 6 inches long with at least 3 nodes. After they are dug, they shall be covered and kept moist until planted.

B. Fertilizer shall be pelleted and shall consist of the following percentages by weight of active ingredients:
   1. For First Application:
      a. Nitrogen: 16 percent

      b. Phosphate: 16 percent

      c. Potash: 16 percent

2. For Second Application:
    a. Nitrogen: 16 percent

    b. Phosphate: 16 percent

    c. Potash: 16 percent

C. Mulch Materials:
    1. Mulch shall be specially-processed fiber containing no growth or germination-factors. It shall be such that any addition and agitation in the hydraulic equipment with seed, fertilizer, water and other additives not be detrimental to plant growth; the fibers will form a homogeneous slurry. When hydraulically sprayed on the soil, the fibers shall form a blotter-like ground cover which readily absorbs water and allows infiltration to the underlying soil.

    2. Stabilizing and water retaining agent for hydro-mulching option only shall be "Verdyol Super", "Ecology Control M-Binder" or approved equal. Rate of application of "Verdyol Super" shall be 50 pounds per acre and that for "Ecology Control M-Binder" shall be 60 pounds per acre.

D. Organic Soil Conditioners: Organic amendments shall be brown, gray, or black in color. It shall be free of live seeds, cuttings, fungus, spores and foul odor. It shall also not contain resins, tannin or other materials in quantities that would be detrimental to plant life.
    1. Soil conditioner shall be one, or a combination of the following:
        a. Burnt bagasse mix shall be a mixture of sugar cane ash, aged sugar cane trash and milled forest waste products.

        b. Redwood shavings shall be a nitrogen-stabilized compost of redwood material passing through a 1/2-inch screen.

        c. Peat Moss.

        d. Shredded hapuu shall be finely shredded hapuu fern.

        e. Composted green waste shall be stabilized compost of recycled green waste material passing through a 1/2-inch screen. The material shall not contain any treated or painted woods.

E. Screened soil for repair work shall be a fertile, friable soil of loamy character, and shall contain organic matter. It shall be obtained from well-drained arable land; be free from weeds, stone and debris; and shall pass a maximum 1/2-inch screen. Screened soil shall be capable of sustaining healthy plant life.

F. Water shall be potable.

PART 3 - EXECUTION

3.01 INSTALLATION AND WORKMANSHIP

A. Site Preparation: Placement of screened soil is to be as shown on plans and details. The Contractor shall accept the condition of the site prior to starting work.

B. Planting: The Contractor shall notify the Engineer one day before planting of grass.
   1. Immediately prior to planting operations, all planting areas shall be cleared of weeds, debris, rocks over one inch in diameter and clumps of earth that will not break up.

   2. Option by Grass Seeding: If grass seeds are used, the following procedure shall be used (NOTE: Contractor should exercise caution in seeding slopes where seeds may be washed away):
      a. The grass seeds shall be broadcast uniformly by hand or by sowing equipment at the rate of 100 pounds per acre. Half the seeds shall be sown with the sower moving in one direction and the remainder shall be sown at right angles to the first direction.

      b. The surface shall then be raked to a smooth even plane while the seeds are simultaneously worked into the soil to a depth of about 1/2-inch.

      c. The surface shall then be smoothed and compacted by means of a culti-packer, roller or other similar equipment weighing 60 to 90 pounds per lineal foot of roller.

      d. The planted area shall then be watered sufficiently to provide water penetration to a depth of at least 2 inches and shall then be kept moist until roots are established.

   3. Option by Grass Sprigging:
      a. Furrows shall be placed perpendicular to drainage aisles and parallel to contours on slopes and shall be spaced no more than 4-inch apart.

      b. Fresh sprigs shall be planted in each furrow a maximum of 6 inches apart and covered with soil to an approximate depth of 2 inches.

      c. The surface shall then be smoothed and compacted by means of a culti-packer, roller or other similar equipment weighing 60 to 90 pounds per lineal foot of roller.

      d. The planted areas shall be watered immediately after rolling in sufficient quantity to provide water penetration to a depth of at least 2 inches and shall then be kept moist until roots are established.

C. Application of Fertilizer: The Contractor shall notify the Engineer one day before application of fertilizer.
   1. Fertilizer shall be distributed uniformly over the planted area.

2. The first application of fertilizer shall be applied at the rate of 300 pounds per acre about 2 weeks after grassing and shall be followed by watering.

3. The second application of fertilizer shall be applied at the rate of 300 pounds per acre about one week before the end of the maintenance period and shall be followed by watering.

D. Maintenance:
   1. General: The Contractor shall be responsible for the proper care of the grassed areas. Maintenance shall include watering, weeding, mowing, repairing, regrassing and protection, and shall be required until the entire project is accepted, but in any event for a period not less than 45 days after planting of grass.

   2. Watering: After planting of seeds or grass sprigs or mulching the ground shall be watered as deemed necessary by the Contractor to establish a healthy growth. Watering shall be done in a manner that will prevent erosion due to the application of excessive quantities of water, and the watering equipment shall be of a type that will prevent damage to the finished surface.

   3. Weeding: Weeds shall be uprooted and removed completely and in no case shall they be allowed to grow and propagate more seeds. Large holes caused by weeding shall be filled with screened soil and raked level.

   4. Mowing: Grass shall be mowed to a height of one inch whenever the height of grass becomes 1-1/2 inches.

   5. Repairing and Regrassing: When any portion of the surface becomes gullied or otherwise damaged and grass has failed to grow, such areas shall be repaired with screened soil and replanted with grass. Any area of one-foot square or more in which grass has failed to grow after 30 days of maintenance shall be regrassed.

   6. Protection: The grassed areas shall be protected against traffic so that the grass establishes a healthy growth. Grassed areas damaged by traffic shall be replanted.

3.02 ACCEPTANCE OF GRASSING

A. At the time of acceptance, the grass shall have been well-established and shall be given a final weeding and a final mowing to a height of one inch.

B. At the end of the 45-day maintenance period, should there appear areas where grass has failed to grow, such areas shall be replanted with grass, refertilized and maintained beyond the maintenance period until a healthy growth is established.

END OF SECTION

DIVISION 3 - CONCRETE

SECTION 03300 - CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes concrete pad as indicated in the drawings.

1.02 APPLICABLE PUBLICATIONS

A. The publications cited within this specification form a part of this specification to the extent referenced. Unless otherwise indicated, most recent edition of the publication with current revisions and amendments will be enforced.

1.03 SUBMITTALS

A. Submit in accordance with SECTION 01330 - SUBMITTAL PROCEDURES.

B. Product Data: Submit for each concrete mix design. Indicate amounts of mix water to be withheld for later addition at project site.

1.04 DESIGN AND PERFORMANCE REQUIREMENTS

A. Quality Assurance: Day to day quality assurance and testing shall be the responsibility of the Contractor.

B. Strength: Fabricate compressive strength specimens (6 by 12-inch cylinders), cure them in accordance with ASTM C 31 and test them in accordance with ASTM C 39. Acceptance test results will be the average strengths of 2 specimens tested at 28 days. The strength of the concrete will be considered satisfactory so long as the average of 3 consecutive acceptance test results equal or exceed the specified compressive strength, f'c, and no individual acceptance test result falls below f'c by more than 500 psi.

C. Construction Tolerances: A Class "C" finish shall apply to all surfaces except those specified to receive a Class "D" finish. A Class "D" finish shall apply to all surfaces which will be permanently concealed after construction. The surface requirements for the classes of finish required shall be as specified in ACI 347.

D. Concrete Mixture Proportions: Concrete mixture proportions shall be the responsibility of the Contractor. Mixture proportions shall include the dry weights of cementitious material(s); the nominal maximum size of the coarse aggregate; the specific gravities, absorptions, and saturated surface-dry weights of fine and coarse aggregates; the quantities, types, and names of admixtures; and quantity of water per cubic yard of concrete. All materials included in the mixture proportions shall be of the same type and from the same source as will be used on the project. Specified compressive strength f'c shall be 3,000 psi at 28 days. The maximum nominal size coarse aggregate shall be 3/4-inch, in accordance with ACI 318/318R. The slump shall be between 3 and 5 inches. Contractor has the option to use high range water reducer (superplasticizer) to increase slump up to 8 inches maximum. The maximum water cement ratio shall be 0.50.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cementitious Materials: Portland Cement shall conform to ASTM C150, Type I/II.

B. Aggregates: Fine and coarse aggregates shall meet the quality and grading requirements of ASTM C33 Class Designations 4M or better.

C. Admixtures: Admixtures to be used, when required or approved, shall comply with the appropriate specification listed. Chemical admixtures that have been in storage at the project site for longer than 6 months shall be retested at the expense of the Contractor and shall be rejected if test results are not satisfactory.
   1. Water-Reducing or Retarding Admixture: Water-reducing or retarding admixture shall meet the requirements of ASTM C494, Type A, B, or D.

   2. High-Range Water-Reducer (Superplasticizer): High-range water-reducing admixture shall meet the requirements of ASTM C494, Type F or G.

D. Water: Water for mixing and curing shall be fresh, clean, potable, and free from injurious amounts of oil, acid, salt, or alkali, except that unpotable water may be used if it meets the requirements of COE CRD-C400.

E. Reinforcing Steel: Reinforcing steel bar shall conform to the requirements of ASTM A615, Grade 60.

F. Formwork: The design and engineering of the formwork as well as its construction, shall be the responsibility of the Contractor.

G. Form Coatings: Forms for exposed surfaces shall be coated with a nonstaining form oil, which shall be applied shortly before concrete is placed.

H. Curing Materials: Curing materials shall conform to the following requirements.
   1. Impervious Sheet Materials: Impervious sheet materials, ASTM C171, type optional, except polyethylene film, if used, shall be white opaque.

   2. Membrane-Forming Curing Compound: ASTM C309, Type 1-D or 2, Class A.

PART 3 - EXECUTION

3.01 PREPARATION

A. General: Construction joints shall be clean, damp, and free of laitance. Standing or flowing water, loose particles, debris, and foreign matter shall have been removed. Spare vibrators shall be available.

B. Embedded Items: Reinforcement shall be secured in place; joints, anchors, and other embedded items shall have been positioned. Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Internal ties shall be arranged so that when the forms are removed the metal part of the tie will not be less than 2 inches from concrete surfaces permanently exposed to view or exposed to water on the finished

structures. Embedded items shall be free of oil and other foreign matters such as loose coatings or rust, paint, and scale. The embedding of wood in concrete will not be permitted. All equipment needed to place, consolidate, protect, and cure the concrete shall be at the placement site and in good operating condition.

C. Formwork Installation: Forms shall be properly aligned, adequately supported, and mortar-tight. The form surfaces shall be smooth and free from irregularities, dents, sags, or holes when used for permanently exposed faces.

D. Production of Concrete:
   1. Ready-Mixed Concrete: Ready-mixed concrete shall conform to ASTM C94 except as otherwise specified.

   2. Batching and Mixing Equipment: The Contractor shall have the option of using an on-site batching and mixing facility. The facility shall provide sufficient batching and mixing equipment capacity to prevent cold joints. The method of measuring materials, batching operation, and mixer shall be submitted for review. On-site plant shall conform to the requirements of either ASTM C94 or ASTM C685.

3.02 CONVEYING AND PLACING CONCRETE

A. Conveying and placing concrete shall conform to the following requirements:
   1. General: Concrete placement shall not be permitted when weather conditions prevent proper placement and consolidation without approval. When concrete is mixed and/or transported by a truck mixer, the concrete shall be delivered to the site of the work and discharge shall be completed within 1-1/2 hours. Concrete shall be conveyed from the mixer to the forms as rapidly as practicable by methods which prevent segregation or loss of ingredients. Concrete shall be in place and consolidated within 15 minutes after discharge from the mixer. Concrete shall be deposited as close as possible to its final position in the forms and be so regulated that it may be effectively consolidated in horizontal layers 18 inches or less in thickness with a minimum of lateral movement. The placement shall be carried on at such a rate that the formation of cold joints will be prevented.

   2. Consolidation: Each later of concrete shall be consolidated by rodding, spading, or internal vibrating equipment. Internal vibration shall be systematically accomplished by inserting the vibrator through the fresh concrete in the layer below at a uniform spacing over the entire area of placement. The distance between insertions shall be approximately 1.5 times the radius of action of the vibrator and overlay the adjacent, just-vibrated area by a few inches. The vibrator shall penetrate rapidly to the bottom of the layer and at least 6 inches into the layer below, if such a layer exists. It shall be held stationary until the concrete is consolidated and then withdrawn slowly at the rate of about 3 inches per second.

   3. Hot-Weather Requirements: When the rate of evaporation of surface moisture, as determined by use of Figure 1 of ACI 308R, is expected to exceed 0.2 psf per hour, provisions for windbreaks, shading, fog spraying, or covering with a light-colored material shall be made in advance of placement,

and such protective measures shall be taken as quickly as finishing operations will allow.

3.03 FORM REMOVAL

A. Forms shall not be removed before the expiration of 24 hours after concrete placement except where otherwise specifically authorized. Supporting forms and shoring shall not be removed until the concrete has cured for at least 5 days. When conditions on the work are such as to justify the requirement, forms will be required to remain in place for longer periods.

3.04 FINISHING

A. Finishing Formed Surfaces: All fins and loose materials shall be removed, and surface defects including tie holes shall be filled. All honeycomb areas and other defects shall be repaired. All unsound concrete shall be removed from areas to be repaired. Surface defects greater than 1/2 inch in diameter and holes left by removal of tie rods in all surfaces not to receive additional concrete shall be reamed or chipped and filled with dry-pack mortar. The prepared area shall be brush-coated with an approved epoxy resin or latex bonding compound or with a neat cement grout after dampening and filled with mortar or concrete. The cement used in mortar or concrete for repairs to all surfaces permanently exposed to view shall be a blend of Portland cement and white cement so that the final color when cured will be the same as adjacent concrete.

B. Finishing Unformed Surfaces: All unformed surfaces that are not to be covered by additional concrete or backfill shall be float finished to elevations shown, unless otherwise specified. Surfaces to receive additional concrete or backfill shall be brought to the elevations shown and left as a true and regular surface. Exterior surfaces shall be sloped for drainage unless otherwise shown. Joints shall be carefully made with a jointing tool. Unformed surfaces shall be finished to a tolerance of 3/8 inch for a float finish and 5/16 inch for a trowel finish. As determined by a 10-foot straightedge placed on surfaces shown on the plans to be level or having a constant slope. Finishing shall not be performed while there is excess moisture or bleeding water on the surface. No water or cement shall be added to the surface during finishing.
   1. Float Finish: Surfaces to be float finished shall be screeded and darbied or bullfloated to eliminate the ridges and to fill in the voids left by the screed. In addition, the darby or bullfloat shall fill all surface voids and only slightly embed the coarse aggregate below the surface of the fresh concrete. When the water sheen disappears and the concrete will support a person's weight without deep imprint, floating should be completed. Floating should embed large aggregates just beneath the surface, remove slight imperfections, humps, and voids to produce a plane surface, compact the concrete, and consolidate mortar at the surface.

3.05 CURING AND PROTECTION

A. Beginning immediately after placement and continuing for at least 7 days, all concrete shall be cured and protected from premature drying, extremes in temperature, rapid temperature change, mechanical damage, and exposure to rain or flowing water. All materials and equipment needed for adequate curing and protection shall be available and at the site of the placement prior to the start

of concrete placement. Preservation of moisture for concrete surfaces not in contact with forms shall be accomplished by one of the following methods:

1. Continuous sprinkling or ponding.

2. Application of absorptive mats or fabrics kept continuously wet.

3. Application of impervious sheet material conforming to ASTM C171.

4. Application of membrane-forming curing compound conforming to ASTM C309, Type 1-D, on surfaces permanently exposed to view and Type 2 on other surfaces shall be accomplished in accordance with manufacturer's instructions.

5. The preservation of moisture for concrete surfaces placed against wooden forms shall be accomplished by keeping the forms continuously wet for 7 days. If forms are removed prior to end of the required curing period, other curing methods shall be used for the balance of the curing period. During the period of protection removal, the temperature of the air in contact with the concrete shall not be allowed to drop more than 25 degrees F within a 24-hour period.

3.06 TESTS AND INSPECTIONS

A. General: The individuals who sample and test concrete as required in this specification shall have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to the ACI minimum guidelines for certification of Concrete Field Testing Technicians, Grade I.

B. Inspection Details and Frequency of Testing:
   1. Perform at least one set of test specimens, for compressive strength as appropriate, on each different concrete mixture placed during the day for each 100 cubic yards or portion thereof of that concrete mixture placed each day.

   2. Preparations for Placing: Forms and embedded items shall be inspected in sufficient time prior to each concrete placement by the Contractor to certify that it is ready to receive concrete.

   3. Consolidation and Protection: The Contractor shall ensure that the concrete is properly consolidated, finished, protected, and cured.

C. Action Required:
   1. Placing: The placing foreman shall not permit placing to begin until he has verified that an adequate number of acceptable vibrators, which are in working order and have competent operators, are available.

D. Reports: The results of all test and inspections conducted at the project site shall be reported informally at the end of each shift and in writing weekly and shall be delivered within 3 days after the end of each weekly reporting period.

END OF SECTION

DIVISION 16 - ELECTRICAL

SECTION 16011 - GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. This section specifies the general electrical requirements for all labor, materials, equipment, and services provided under DIVISION 16 - ELECTRICAL.

B. Related Work Described Elsewhere:
   1. DIVISION 2 - SITE CONSTRUCTION.

   2. SECTION 03300 - CONCRETE.

1.02 WORK INCLUDED

A. The Contractor under this Division shall provide all labor, materials, equipment, supervision and services required for the construction of the electrical systems. The finished installations shall be complete, operable and shall include all work specified herein and shown on the Drawings.

B. The work shall include complete testing of all equipment and wiring at the completion of the work and making any minor connection changes or adjustments necessary for the proper functioning of the system and equipment. All systems shall be properly adjusted and in working order at the time of final acceptance.

C. All concrete, steel reinforcement, miscellaneous metal-work, earthwork, and grouting shall conform to the applicable requirements of the detailed equipment specifications as prescribed in appropriate sections.

D. It is the intent of these Specifications and other Contract Documents to require an installation complete in every detail. Consequently, the Contractor will be responsible for minor details or for any special construction which may be found necessary to properly furnish, install, adjust, test, and place in successful and continuous operation, the entire electrical system and the cost of same shall be included in the contract price.

1.03 DESCRIPTION OF WORK

A. Work specified in this Division shall include, but not be limited to the following:
   1. Secondary electrical distribution system including overcurrent protection devices, and feeders.

   2. Complete electrical system wiring including branch circuits and control devices.

   3. Emergency generator, automatic transfer switch, and control system.

   4. Include in the bid and pay for the permits, inspection fees and deliver the certificate of final inspection to Engineer.

5. Testing.

1.04 REFERENCES

A. Comply with local ordinances; National Electrical Code; National Electrical Safety Code; applicable regulations of the National Board of Fire Underwriters; specifications of ANSI, NEMA, UL, IES, and IPCEA; and regulations of the City and County of Honolulu.

B. In the event of conflict between pertinent codes and regulations, and the requirements of the referenced standards, or those indicated in Specifications and on drawings, the provisions of the more stringent shall govern.

1.05 SUBMITTALS

A. Submit in accordance with SECTION 01330 - SUBMITTAL PROCEDURES.

B. Certificates:
   1. Submit written certification that electrical systems are complete and operational as stipulated in item entitled “DEMONSTRATION OF COMPLETE ELECTRICAL SYSTEMS” hereinbelow.

   2. Submit certificate of final inspection and acceptance as stipulated in item entitled “INSPECTION” hereinbelow.

C. Test records.

D. Warranty: Submit warranty as stipulated in item entitled “WARRANTY” hereinbelow.

E. As-Built Drawings: Submit in accordance with SECTION 01770 - CLOSEOUT PROCEDURES.

1.06 QUALITY ASSURANCE

A. In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, “shall” had been substituted for “should” wherever it appears. Interpret references in these publications to the “authority having jurisdiction,” or words of similar meaning, to mean the Engineer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

B. Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers’ catalogs, or brochures during the 2-year period. Where 2 or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

C. Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

D. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70.

1.07 PERMITS

A. All permits required by local ordinances shall be obtained and paid for by the Contractor.

1.08 COORDINATION

A. Refer to all project Drawings and to all Sections of the project Specifications. Coordinate and fit all work accordingly so that all electrical outlets and equipment will be properly located and readily accessible. The Drawings indicate the relation of wiring and connections and must not be scaled for exact locations.

B. Verify all construction dimensions at the project and make changes necessary to conform to the facility as constructed. Work improperly installed due to lack of construction verification shall be corrected at the Contractor's expense.

C. Work shall be scheduled to avoid delays, interferences, and unnecessary work. If any conflicts occur, necessitating departures from the Drawings and Specifications, details of departures and reasons therefore shall be submitted immediately for consideration by the Engineer.

1.09 DELIVERY, HANDLING AND STORAGE

A. Deliver all materials of this Division in manufacturer's original unopened packages or containers with label intact and legible.

B. Use means necessary to protect the materials of this section before, during and after installation; to protect the installed work and materials of all other trades; and to protect the original structure, work and materials of the State.

C. In the event of damage, immediately make all repairs and replacements necessary to the acceptance of the Engineer and at no additional cost to the State.

1.10 DRAWINGS AND SPECIFICATIONS

A. Electrical system drawings are diagrammatic and symbolic. Locations of outlets, devices, raceways, apparatus, etc., shown are approximate and shall be installed with the required maintenance and code clearances and to avoid conflict with other systems and trades. Visit site and verify lineal footages required and check scales and dimensions shown on architectural drawings prior to bidding to verify locations, routing and lineal footages of electrical work required for inclusion into bid. Study the project drawings and specifications, and make installation in most logical manner for eye appeal and coordination with other systems and trades. Unless dimensioned or noted otherwise, orderly configuration and visual composition are fully intended.

B. Include additional components and wiring which are not shown or specified herein but are required for proper control and operation to provide for a complete and operable system within intent indicated on the drawings and specifications.

C. Study the project drawings and specifications prior to bidding and provide additional wiring including apparatus and devices for equipment furnished by others without additional cost.

D. Relocate devices, apparatus and associated wiring including raceways, from locations shown, without additional cost, for code compliance and to avoid conflict with other systems or trades, structures, utilities and when directed before installation.

E. Equipment ratings or wire sizes that are missing or shown in error shall have adequate capacity to serve the required and future loads plus minimum 25 percent spare capacity, and be in compliance with NEC.

F. Verify voltages and other ratings of energy conversion, transformation and electrical utilization equipment prior to placing order with factory. Input voltages of equipment shall match serving utility or system voltage available.

1.11 POSTED OPERATING INSTRUCTIONS

A. Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:
   1. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

   2. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

   3. Safety precautions.

   4. The procedure in the event of equipment failure.

   5. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

B. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.12 MANUFACTURER'S NAMEPLATE

A. Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.13 WARRANTY

A. Installation shall be complete in every detail as specified and ready for use. Unless otherwise indicated, any items supplied by Contractor developing defects

of design, construction, or quality within one year of final acceptance by Engineer shall be replaced by such new materials, apparatus or parts to make such defective portion of the complete system conform to the true intent and meaning of the Drawings and Specifications at no additional cost to the State.

B. The warranty shall be countersigned by the General Contractor.

PART 2 - PRODUCTS

2.01 MATERIALS AND WORKMANSHIP

A. All materials shall conform to the latest issue of all applicable standards as established by NEMA, NFPA, ANSI, IEEE, IES, ASTM and Underwriters' Laboratories, and shall bear the manufacturer's name and trade name and when available, the Underwriters' Label.

B. Neat appearances in the finished work will be required. Only experienced electrical workers shall be employed for the electrical installation.

C. All work not installed and completed in accordance with the latest rules and regulations of the NEC, OSHA and all local ordinances shall be removed and reinstalled correctly at the Contractor's expense.

PART 3 - EXECUTION

3.01 GENERAL

A. Install all electrical materials and equipment in accordance with manufacturer's recommendations and as accepted by the Engineer for the seismic zone classification at the project site in accordance with the Building Code.

B. Cut, break, 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. Patch any damaged surfaces to match the existing surface.

C. All wiring and overcurrent devices for equipment furnished by other trades are sized for a contemplated equipment size. If equipment other than contemplated and indicated on the plan is provided, the Contractor shall be responsible for providing the required wiring, switches, and overcurrent devices at no cost to the State. The Contractor shall submit the proposed revisions to the electrical design to the Engineer for acceptance.

D. The Electrical Contractor shall coordinate his work with other trades to avoid conflicts with civil, structural and landscape elements of this project.

3.02 JOBSITE CONDITIONS

A. These specifications are accompanied by construction drawings including building and site plans of all trades showing locations of all outlets, switches, service runs, feeder runs, devices, and other electrical equipment. The locations are approximate and before installing, study adjacent architectural details and

make installation in most logical manner. Any device may be relocated within 10 feet before installation at the direction of the Engineer without additional cost to the State.

B. Before installing, verify all dimensions and sizes of equipment.

C. Verify that electrical system may be installed in strict accordance with the original design, the Drawings and Specifications and the manufacturer's recommendations.

D. In the event of discrepancy, immediately notify the Engineer. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.03 DEMONSTRATION OF COMPLETE ELECTRICAL SYSTEMS

A. Submit written certification that electrical systems are complete and operational. Submit certification with Contractor's request for final review.

B. At the time of final review of electrical work, demonstrate the operation of electrical systems. Provide labor, apparatus and equipment for systems' demonstration. The various tests shall be under the direction and supervision of the Engineer.

C. The Contractor shall provide all test equipment, materials, labor, and temporary power hook-ups to perform start-up and all tests as required, to obtain final field acceptance from the State. All tests shall be conducted in the presence of the Engineer or his representative. All test procedures shall conform to this specification and applicable standards. (ANSI, IEEE, NEMA, OSHA, NFPA, NETA, etc.)

D. The Contractor shall be responsible for all tests and test record. Testing shall be performed by and under the immediate supervision of the Contractor. Test record shall be kept for each piece of equipment. Copies shall be furnished to the Engineer for his review and/or acceptance.

E. A visual inspection of all electrical equipment, to check for foreign material, tightness or wiring and connection, proper grounding, matching nameplate charts with specification, etc., shall be made prior to actual testing.

F. After demonstration of systems, submit to the Engineer 6 sets of keys for electrical equipment locks.

3.04 INSPECTION

A. Arrange for periodic inspection by the local authorities and deliver the certificate of final inspection to the Engineer.

END OF SECTION

SECTION 16100 - ELECTRICAL WORK

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes, but is not limited to, the following electrical work items:
   1. Overcurrent protection devices, manual transfer switches and feeders.

   2. Electrical work to support branch circuiting and equipment connections.

   3. Testing and completion.

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. SECTION 16011 - GENERAL ELECTRICAL REQUIREMENTS, applies to this section with additions and modifications specified herein.

1.03 APPLICABLE PUBLICATIONS

A. The publications cited within this specification form a part of this specification to the extent referenced. Unless otherwise indicated, most recent edition of the publication with current revisions and amendments will be enforced.

1.04 SUBMITTALS

A. Submit in accordance with SECTION 01330 - SUBMITTAL PROCEDURES.

B. Shop Drawings: Three-way manual transfer switch.

C. Manufacturer's Data:
   1. Circuit breakers.

   2. 3-way manual transfer switches.

   3. Junction boxes with dimensions 6 inches and larger.

D. Test Reports: Submit written notification of all interior electrical work test reports as indicated in item entitled "TESTING" hereinbelow.

PART 2 - PRODUCTS

2.01 GENERAL

A. Materials shall be new, and those items listed by the Underwriters' Laboratories shall bear "UL" label of approval.

B. Brand names, manufacturer's names and catalog numbers indicate standard of design and quality required. All apparatus supplied shall bear the name of the approved manufacturer on its nameplates. Substitute materials may be used if pre-qualified prior to bidding by the Engineer.

C. Electrical equipment and luminaires shall be supplied through the manufacturer's designated representative by a local distributor.

D. Proof of compliance shall be furnished when shop drawings are submitted.

E. All apparatus shall be of the same manufacture.

F. NEMA 3R or 4X housings shall be provided.

2.02 RACEWAYS

A. Rigid Steel Conduit: Rigid steel, zinc-coated inside and outside, for use with threaded fittings. ANSI C80.1.

B. Flexible Metal Conduit: Flexible steel conduit; zinc-coated inside and outside, smooth inside walls, liquid-tight with factory fittings for liquid-tight installation. Provide bushings with bonding jumper lugs for flexible conduit in excess of 6 feet in length. UL 360.

C. Plastic Conduit: Polyvinyl chloride, Schedule 40. Provide a separate green equipment grounding conductor.

2.03 BOXES

A. Cast steel, Type FD.

B. Large Junction Boxes (6-inches and larger): NEMA 4X, stainless steel #302, Hoffman, Carlon, Robroy, or pre-approved equivalent. Boxes 24-inches and larger shall have hinged door with a minimum of 2 stainless steel captive screws on the latch side of the door.

2.04 CONDUCTORS

A. Solid or stranded copper, sizes according to American Wire Gauge Wire, as shown on Drawings and #12 AWG minimum unless otherwise indicated. Solid conductors only for #10 AWG and smaller. All wiring shall be color-coded.

B. Branch Circuits: Type THWN.

C. Conductors Larger than #8 AWG: THWN or XHHW.

D. Conductors for Equipment Connection: Stranded flexible type.

2.05 3-WAY MANUAL TRANSFER SWITCH

A. UL 1008. Completely factory assembles, wired and tested. Molded case breaker type. Knife switch or fused switches not acceptable.

B. 3-way manual transfer switch shall consist of three mechanically-interlocked molded case circuit breakers, male cam-style inlet connectors, female-style outlet connectors, power distribution blocks and grounding terminals, all housed within a padlockable enclosure.

C. Transfer switch enclosure shall be stainless steel, NEMA Type 3R. The main access shall be through an interlocked hinged door that extends the full height of the enclosure. Access for portable generator cables with female cam-style plugs and for load bank cables with male cam-style plugs shall be via drawn flange cable entry openings in the bottom of the enclosure. A hinged flap door shall allow cable entry only after the main access door has been opened.

D. Cam-style male and female connectors shall be UL listed, single-pole separable type and rated 400 amps at 600 VAC. All cam-style connectors shall be color coded. Cam-style connectors shall be provided for each phase, neutral and ground. Each of the phase cam-style connectors shall be factory wired to a molded case circuit breaker. The ground cam-style connector shall be bonded to the enclosure and a ground lug shall be provided for connection of the facility ground conductors. None of the cam-style connectors shall be accessible unless all three molded case circuit breakers are in the "OFF" position and the main access door is open.

E. A power distribution block shall be provided for load-side field wiring. The power distribution block shall be factory wired to the molded case circuit breakers.

F. Molded case circuit breakers shall be UL listed with AIC ratings as indicated. One molded case breaker shall control the connection between the permanent generator and the automatic transfer switch. The second circuit breaker shall control the connection between the permanent generator and the load bank female cam-style connectors. The third circuit breaker shall control the connection between the automatic transfer switch and the portable generator male cam-style connectors. The three molded case circuit breakers shall be safety interlocked as follows:
   1. With the breaker controlling the connection between the permanent generator and automatic transfer switch in the "ON" position, neither of the other two breakers can be turned to the "ON" position.

   2. With the breaker controlling the connection between the permanent generator and the automatic transfer switch in the "OFF" position, the other two breakers can be turned "ON" or "OFF," independent of each other.

   3. With the breaker controlling the connection between the permanent generator and the automatic transfer switch in the "OFF" position and with either or both of the other two breakers in the "ON" position, the breaker controlling the connection between the permanent generator and automatic transfer switch cannot be turned "ON."

2.06 CIRCUIT BREAKERS

A. Circuit breakers, unless otherwise shown, shall be molded case, toggle mechanism operated, with no-fuse ambient-compensated thermal-magnetic overload automatic trip units for overcurrent and short-circuit protection, interchangeable trip units when available and contacts rated to interrupt short-circuit currents as specified on Drawings. Non-automatic breakers shall have short circuit withstand ratings as specified on Drawings. Multi-pole breakers shall have single, common operating handle for all poles.

B. Enclosures shall be NEMA 3R or 4X as indicated.

2.07 HARDWARE, SUPPORTS, BACKING, ETC.

A. Provide all hardware, supports, backing and other accessories necessary to install electrical equipment. Wood materials shall be treated against termite, iron or steel materials shall be galvanized for corrosion protection, and non-ferrous materials shall be brass or bronze.

B. Bolts, nuts, washers, and screws used for outside shall be high quality stainless steel or brass.

C. Ground Rods: Ground rods shall be copper clad steel type, 3/4-inch diameter, 10 feet long, sectional type, and conform to UL 467.

2.08 DUCT SEAL

A. Pliable, non-toxic material used for application around conductors in raceway and in empty conduits to minimize moisture and rodent/insect infiltration. Must be re-enterable material allowing for removal/reapplication after initial installation. Non-drying, non-cracking, non-corrosive material that will not adversely affect raceway and conductors. Provide duct seal at all duct entries in handholes, apparatus, and risers to prevent water infiltration via duct system.

PART 3 - EXECUTION

3.01 RACEWAYS

A. Use conduits with approved coupling and connectors. All cuts square, using saw. Ream the ends. Bends made with approved tools. Reject flattened or crushed conduit. No running thread. Bushing and 2 locknuts at connection to boxes and enclosures.

B. All raceways shall be blown and swabbed after installation to remove any water, then immediately sealed to prevent water and debris infiltration during construction. Raceways must remain sealed except when pulling conductors. If water is discovered during the warranty period, the Contractor shall remove water from raceways and associated boxes at no additional cost to the State.

C. Exposed conduit runs to be parallel and/or perpendicular to architectural and structural elements.

D. Non-metallic conduits only permitted for exterior ductlines. Exposed installation of non-metallic conduit not permitted.

E. Minimum conduit diameter shall be 3/4-inch trade size.

F. Provide nylon pullstring of 200-pound minimum tensile strength in all empty conduits in excess of 15 feet in length.

3.02 BOXES

A. Plumb and securely fasten. Flush boxes - exactly flush; apply form oil so that stray concrete can be removed readily. Remove all debris from interior.

B. All outlet boxes must be cleaned of debris prior to cable installation.

3.03 CONDUCTORS

A. Lubricants: Non-wax type, chemically neutral to insulation and sheath. Mechanical means for pulling to be torque-limiting type and not be used for #2 AWG and smaller wires.

B. No-solder pressure connectors or crimp connections for #8 AWG and larger wires. Remove all sharp points that can pierce tape. Reinsulate according to wire manufacturer's directions.

C. Clean all raceways, boxes, and enclosures before pulling wires and cables. Form neatly in enclosures for minimum of cross-overs.

3.04 MISCELLANEOUS DETAILS

A. Provide necessary foundations, supports, backing, etc., for all raceways and equipment. Attach to wood and steel by screws or bolts. Attach to concrete by expansion anchors. Powder charge driven studs and anchors shall not be used.

B. Clean all surfaces of enclosures and equipment.

C. Close all unused knockout holes.

3.05 IDENTIFICATION

A. All overcurrent protection devices, enclosures, and cabinets shall be provided with plastic plate identifying itself and its use.
   1. Identify all switches and self-contained breakers where not mounted on equipment.

B. Plastic plate shall be laminated black and white, engraved 1/4-inch high lettering to expose black layer. Plate shall be riveted to the cover and located directly below device handle, or top side of door.

C. CAUTION SIGNS shall be provided as required by Ordinances and/or by OSHA.

3.06 TESTING

A. Upon completion of this portion of work, and prior to its acceptance by the State, make all required tests and secure all required approval from agencies having jurisdiction. Any deficiencies found shall be rectified and work affected by such deficiencies shall be completely retested at Contractor's expense. Written notification of all proposed tests shall be provided to the Engineer a minimum of 14 days prior to the date of the test.

B. Perform an operational test after completion of the installation in the presence of the Engineer, to assure proper operation of all items of work. Remove all grounds and shorts. Balance feeder loads.

C. Measure resistance of grounding system at service and furnish 3 copies of results to the Engineer.

END OF SECTION

SECTION 16208 - ENGINE GENERATOR SET

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes, but is not limited, to the following items:
   1. Diesel engine-generator set including but not limited to exhaust system, cooling system, fuel system, starting system, and the generator control/alarm systems.

   2. Testing and maintenance requirements.

1.02 RELATED WORK

A. SECTION 16011 - GENERAL ELECTRICAL REQUIREMENTS applies to this section with additions and modifications specified herein.

B. SECTION 16100 - ELECTRICAL WORK applies to this section with additions and modifications specified herein.

C. SECTION 16262 - AUTOMATIC TRANSFER SWITCHES applies to this section with additions and modifications specified herein.

1.03 APPLICABLE PUBLICATIONS

A. The publications cited in this specification form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. Unless otherwise indicated, most recent edition of the publication with current revisions and amendments will be enforced.

1.04 INTENT

A. This specification describes the equipment required. It does not cover all phases of manufacture or assembly. The Contractor shall assume the responsibility for providing well-integrated units of high quality.

B. Equipment, materials, installation, and workmanship shall be in accordance with the required and advisory provisions of NEPA. Materials not normally furnished by the manufacturer of the equipment shall be provided in accordance with other sections of DIVISION 16 - ELECTRICAL unless otherwise noted.

1.05 STANDARDS AND CODES

A. The equipment covered by this specification shall be designed, tested and assembled in accordance with the applicable standards of ANSI, IEEE and NEMA, as minimum requirements for all items.

B. The equipment shall comply with NEC, OSHA and all pertinent Federal, State and Local Codes, regulations and ordinances, including UL approval if required.

1.06 SUBMITTALS

A. Submit in accordance with SECTION 01330 - SUBMITTAL PROCEDURES.

B. Equipment Data:
   1. Provide complete specifications of all proposed equipment including fuel consumption data, outline drawings showing approximate dimensions, weights and complete performance data.

   2. A complete physical and technical description of the excitation system regulation system, cooling system, etc. shall be provided.

   3. A statement is required that the equipment to be furnished will be in accordance with this specification. Any exceptions must be listed in detail.

C. Shop Drawings:
   1. Equipment List.

   2. General arrangements and mounting details, including location and size of all connections and foundation requirements.

   3. Drawings and/or catalog cuts showing complete layouts, details, dimensions, weights, and installation instructions of sets and accessories, including lubrication-oil cooler, radiator, exhaust silencer, transfer pump, turbo-charger, fuel oil storage tank, etc.

   4. Schematic and wiring diagrams of all power, control, filtering, monitoring, metering and any other circuiting.

   5. Outlines, front view, sections of control panel and main circuit breaker.

   6. Battery, chargers, and connection diagrams.

   7. Fuel oil, lube oil, cooling water piping and wiring diagram.

   8. Concrete pad recommendation, layout, and stub-up locations of electrical fuel systems.

   9. Factory sound test results and manufacturer certification to demonstrate compliance with sound pressure requirements.

   10. Manufacturer-certified test results and logs of rated load tests at rated power factor.

   11. Certification of compliance with EPA emission specifications.

   12. Manufacturer-certified vibration isolation system.

   13. Electrical drawings showing routing and fitting locations.

   14. Paint sample finish color of sound attenuated enclosure.

D. Terminal block and lug numbers for all external connections shall be same as shown on the elementary diagrams and shall be identified in a manner to distinguish them from internal interconnecting points.

E. Shop drawings shall have sufficient information so that they may be considered for approval without reference to detail drawings. No shop drawings will be considered for approval which, in the opinion of the Engineer, is contingent upon approval of other features for approval if such features are not incorporated into the shop drawings. If changes or corrections are necessary, resubmit the corrected shop drawings using the same procedures as the original submission. It is understood that the approval of the Contractor's shop drawings, whether general or detailed, is a general approval relating only to their sufficiency and compliance with the intention of the design and shall not excuse or constitute an acceptance of errors, discrepancies, or omissions, or waiver of detailed requirements.

F. Operating Instructions: Submit operating instructions as stipulated in item entitled “OPERATION AND MAINTENANCE MANUALS” hereinbelow.

G. Warranty: Submit warranty as stipulated in item entitled “WARRANTY” hereinbelow.

H. Maintenance Service Contract: Submit maintenance service contract as stipulated in item entitled “MAINTENANCE SERVICE CONTRACT” hereinbelow.

1.07 OPERATION AND MAINTENANCE MANUALS

A. Submit in accordance with SECTION 01770 - CLOSEOUT PROCEDURES. The manual shall include the following:
   1. Operating instructions and maintenance procedures for all components.
   2. Recommended spare parts list containing information of components, manufacturer's name and catalog number and price.
   3. Approved and certified shop drawings.
   4. Certified test log of engine-generator data taken during Check Out and Acceptance Testing.

1.08 MATERIAL

A. All materials and parts comprising the units herein specified shall be new and unused, of current manufacture, and of the highest grade, free from all defects or imperfections affecting performance. Workmanship shall be of the highest grade, in accordance with modern practice.

B. The unit shall be the product of a firm regularly engaged in the manufacture of engines and generators and shall meet the requirements of the specifications set forth herein. It must be of a standard model in regular production at the manufacturer’s place of business.

1.09 PARTS AND SERVICE

A. The diesel electric generator set shall be such that it can be properly maintained and serviced without the necessity of the User carrying expensive part stocks, or being subjected to the inconvenience of long periods of interrupted services due to lack of available parts.

B. The vendor shall specify nearest location of permanent parts depots in the State of Hawaii from which the parts may be obtained in necessary quantities at any time during the day or night. The engine supplier shall have complete parts and factory authorized service facilities on Oahu with 24-hour trouble call.

1.10 WARRANTY

A. The Contractor shall warranty all equipment which he provides for a period of one year from the date of final project acceptance.

B. The Contractor shall promptly correct any deficiencies in the equipment provided which occur during the warranty period at the site at no additional cost. This shall include all costs for material and labor for all such corrective work.

1.11 MAINTENANCE SERVICE CONTRACT

A. The Contractor shall provide extended testing and maintenance services for the engine generator system for a period of one year from the date of final project acceptance.

B. The Contractor shall include all material, equipment and labor costs for performing maintenance work in his Bid.

PART 2 - PRODUCTS

2.01 DIESEL ENGINE-GENERATOR SET

A. The engine-generator system shall be complete factory assembled, installed, wired, tested, conforming with the National Electrical Code.

B. Engine-generator set shall be certified to Stationary Emergency Certified exhaust emission levels in accordance with U.S. EPA emissions standards and regulations.

C. Engine shall be capable of starting as a fully compression-ignition engine on No. 2 diesel fuel at any condition within 0 degrees F to 120 degrees F at sea level. The engine shall accelerate to rated speed and accept full load within 10 seconds maximum. Diesel engines requiring premium fuel will not be considered.

D. Critical Speeds: Complete engine-generator set shall be free of critical speeds of either a major or minor order which would endanger or impair satisfactory operation of the sets.

E. Rating:
   1. Engine-generator set shall be capable of producing the indicated kilowatts of standby power at 0.8 lagging power factor of 3-phase, the 208/120V service voltage, 60 Hertz AC continuously (24 hours a day) without adverse effects when operating at 1800 rpm under any ambient conditions from 0 degrees F to 120 degrees F at sea level.

2. Engine shall have a useful shaft output (all accessory power subtracted) of not less than 100 percent of the generator input requirement (output/certified efficiency) based on its cataloged and certified maximum horsepower, whichever is less.

3. Rating of the diesel generator set shall be based on operating of the set at rated generator RPM when equipped with all necessary operating accessories such as air cleaners, radiator pumps, radiator fans, lubricating oil pump, fuel transfer pump, fuel injection pump, jacket water pump, governor, AC generator and exciter.

F. Performance:
1. Frequency: Upon completion or removal of full-rated load in one step, set shall recover to stabilized speed within 5 seconds after full rated load is applied in one step and the frequency shall vary by not more than 25 percent (15 Hertz). Under steady-state conditions, the maximum frequency minus the minimum frequency shall not exceed 0.25 hertz.

2. Voltage: Under steady-state conditions, the voltage regulation shall not exceed 0.5 percent for any load between no load and full load, at any constant ambient temperature between minus 20 degrees F and 120 degrees F. Upon completion of full-rated load in one step, the voltage shall vary by not more than 30 percent and shall recover to within the steady-state modulation band within 5 seconds. Generator set shall have a motor starting capability of 157 SKVA with a maximum instantaneous voltage dip of no more than 30 percent based on NEMA MG-1 standard. Motor starting data based on sustained voltage dip shall not be acceptable.

G. Load Characteristics: The generator set shall be capable of supporting non-linear loads and uninteruptible power supplies connected to the standby power bus. Maximum subtransient reactance of the generator set shall be 12 percent. Units which cannot meet the subtransient restriction will be rejected as unsuitable for service.

H. Control Characteristics:
1. Engine-generator set shall be capable of manual or automatic operation. The engine control circuits shall be designed for 24 volts DC. Selector switch (test-manual-off-auto) shall be provided for the system.

2. Manual Operation: Placing of the selector switch of set from the "OFF" to the "MANUAL" position shall cause the set to start and accelerate to governed speed. Moving the selector switch of the set to the "OFF" position shall cause the starting circuits to open and the set to shut down.

3. Automatic Operation: With the selector switches in the "AUTO" position, set shall start upon the closure of a pair of electrical contacts provided for that purpose. The set shall be actuated through such contacts and will have load transferred to it by an automatic transfer control switching scheme. Upon re-energization of the normal source, load will be removed from the set by the automatic transfer control switching scheme. Engine shall be stopped automatically after a 5-minute cool-down unloaded running time.

2.02 MALFUNCTION AND ALARM

A. Engine: Running of the engine-generator set shall be protected by the following malfunction circuitry:

1. Crank Failure: In the "AUTOMATIC" mode, the engine shall be required to make 4 cranking attempts of 10 seconds duration, with a 10-second reset period and 30-second time delay between cranking attempts. After 4 unsuccessful cranking attempts, the cranking circuit of the malfunctioning engine shall automatically open, the engine shall shut down, a malfunction warning light on its control panel shall go on and an audible alarm shall sound. A reset button shall be provided to permit further cranking attempts.

2. Overspeed: Should the engine, for any reason, reach a speed 10 percent or more above the governed speed, the set shall shut down by means independent of the governor, the main circuit breaker shall be tripped, and the warning light shall illuminate as in subparagraph entitled “Crank Failure” above. An audible alarm shall also be sounded.

3. Low Oil Pressure: Should the lube oil pressure of the engine fall below a preset limit, the same actions shall occur.

4. High Cooling-Water Temperature: Should the jacket water temperature of engine rise above preset double limits, the following shall occur. As the water temperature rises above the first limit, an audible alarm shall be sounded. A temperature rise above the second limit shall result in the shutdown of the set.

B. Generator and Field: Running of engine-generator set shall also activate alarming/protection circuitries for the following electrical malfunctions:

1. Protection loss of excitation, on the generator, complete with current transducer and protective relay.

2. Pre-alarm voltage relay for abnormal generator under/over voltage.

3. Alarm for generator breaker tripped by overcurrent and/or any of the protective relays.

4. All relays and associated accessories shall be made by one manufacturer. Certified equivalent relay vendors are GE, Basler Electric, Eaton, Siemens or the generator manufacturer.

5. All alarms shall be in the forms of visual warning lights and audible horn with silencing button.

2.03 STARTING SYSTEM

A. Engine-cranking motor shall be powered by a 24-volt, heavy duty, lead acid storage battery having sufficient capacity to crank the engine at constant firing speed in minimum room temperature of 0 degrees F for a minimum of 4 cranking attempts. Batteries shall have an ampere-hour capacity (to a terminal voltage of 0.65 volts per cell) as recommended by the engine manufacturer, each battery shall give 100 percent of rated capacity after 200 cycles of charge and discharge,

or shall have a minimum nominal ampere hour capacity of 100 at 10-hour rate whichever is higher.

B. The battery set shall be provided with all intercell connections and connecting cables to the charger and generator.

C. Battery installation shall include a battery rack and a 10-ampere (minimum) battery charger of the automatic solid-state dual-rate type, with magnetic amplifier control from a Zener voltage reference for operation on 120-volt, single phase AC. Charger shall be automatic dual-rate, DC voltmeter, DC ammeter, pilot lights for high-rate and float-charging indication. Fused AC and DC circuit protection. The charger shall have a DC cranking circuit disconnect relay.

D. Battery Alarms: Battery installation shall have alarm provisions for NFPA 110 alarms - high battery voltage, low battery voltage, AC fail, and charger fail. Audible alarm device shall consist of a horn mounted on the generator control panel.

E. The starting pinion shall disengage automatically when engine starts. Glow plugs shall be provided if required.

2.04 CONTROL PANELS

A. Local Control Panel: The local control panel shall be provided in a generator set mounted enclosure with continuous hinged door and lock. Use of analog or digital metering acceptable. Control panel shall contain, but not be limited to the following:

1. Voltmeter, 2 percent accuracy.
2. Ammeter, 2 percent accuracy.
3. Ammeter/Voltmeter phase selector switch.
4. Frequency meter.
5. Starting controls.
6. Panel illumination lights and switch.
7. Voltage level adjustment rheostat.
8. Engine oil pressure gauge and fuel pressure gauge.
9. Engine water temperature gauge and lube-oil temperature gauge.
10. Engine speed adjust (governor reset).
11. All protective and alarm relays with dry contacts for remote alarms, wired to terminal strips.
12. Fault indicators for all alarms listed in item entitled “MALFUNCTION AND ALARM” hereinabove.

13. Low fuel level alarm.

14. Fuel tank leak alarm.

15. Four position function switch marked "test", "manual", "off/reset" and "Auto".

16. Tachometer.

17. Running time meter.

18. Emergency stop (fuel shut-off) pushbutton.

19. Start and glow plug switch, if required.

20. Terminal strips for ring type terminals.

21. Panduit and supports for all panel internal wirings.

22. RS-485 output with Ethernet output converter.

2.05 EXTENSION TERMINAL CABINET

A. A generator-mounted extension terminal cabinet shall be provided in a separate NEMA 1 enclosure and shall be stock mounted by the manufacturer to the generator housing. The box shall be equipped with the following:
   1. Phase and neutral copper busses for rated current and voltage.

   2. Termination of all generator leads.

   3. Grounding bus and shunts as required.

B. The trip unit shall have elements providing inverse time, adjustable solid state short and long time delays and instantaneous trips. The circuit breaker shall meet standards established by Underwriters' Laboratories, National Electric Manufacturer's Association and National Electrical Code and sized to match generator output. The breaker shall be flush mounted in order to be operable and accessible without opening the cabinet door.

2.06 GENERATOR

A. Generator shall be a rotating-field, 3-phase, 4-wire synchronous machine with the indicated continuous rated with kilowatt rating noted on Drawings, at 0.8 lagging power factor, with 208/120 volts wye connected, 4-wire system, 60 hertz AC, when operating at rated speed, and shall be of the single ball-bearing drip-proof, self-ventilated, protected type. The generator insulation system shall be totally encapsulated with Class "H" insulation. Temperature rise shall not exceed NEMA standard. Generator shall be coupled to the engine flywheel through a flexible steel disc. Engine and generator combination shall be mounted on a common structural steel base.

B. The exciter shall be of the brushless type, using a rotating rectifier bridge circuit. Brushes commutators or slip rings will not be permitted. The rectifying unit shall be mounted on the generator rotor shaft and shall supply the field excitation

current for the generator. The exciter shall have a capacity to provide field current for the generator at 125 percent of rated capacity and shall be capable of carrying, without injury, momentary loads of 300 percent of its rated current.

C. The regulator shall employ a programmable volts per Hertz regulation characteristic with adjustable slope (volts/Hertz), adjustable constant voltage corner frequency and adjustable under voltage corner frequency. Sensing shall be 3-phase true RMS. The regulator shall be environmentally sealed.

D. Generator Characteristics:
   1. Voltage adjustment range - 10 percent of rated voltage.

   2. Telephone influence factor (TIF) - 50 (1960) weighting.

   3. Radio and TV interference - negligible.

E. Acceptable Manufacturers: Caterpillar, Cummins or accepted equivalent.

2.07 ENGINE

A. Engine shall be single-acting, full compression-ignition engine with no fewer than 6 cylinders. It shall have a 4-stroke cycle, direct injection of fuel into cylinders or pre-combustion chamber and shall be water-cooled. It may be either vertical in line or V configuration, but shall have trunk pistons. It may be turbo-super-charged.
   1. Cylinder Liners: Cylinders shall be provided with replaceable wet-type full length liners of close grained alloy iron, heat treated for proper hardness and precision honed to obtain maximum life.

   2. The crankshaft shall be of forced steel, statically and dynamically balanced.

B. Pistons shall be aluminum alloy with cast-iron top ring bands and chrome-faced rings.

C. Valve train shall employ replaceable valve seat inserts, alloy steel valves and cast-iron guides.

D. The flywheel, ring gear and flywheel housing shall be of the appropriate SAE construction and shall be designed of fulfill the specified speed regulation and performance requirements.

E. Turbo-super-charger for engine (if used) shall be driven by engine exhaust gas and shall have the turbine and blower wheels on a shaft with ball bearings and grease fittings. Turbo-super-charger shall be easily removable.

F. Governor: Engine shall have electrical (solid state) speed-sensing governor, equipped for future load sharing control. The governor shall be capable of maintaining +/-6 RPM and shall have a transient response time of not more than 5 seconds to restore to steady-state conditions from the application of 100 percent load.

G. The engine shall be provided with all flexible connections of the size, length, and type recommended by the engine manufacturer. Connections shall be provided by fuel intake, fuel return, cooling water outlet, cooling water inlet, radiator, and exhaust.

H. Acceptable Manufacturers: Caterpillar, Cummins or accepted equivalent.

2.08 SOUND ATTENUATED ENCLOSURE

A. The complete diesel engine generator set, including generator control panel, engine starting batteries and fuel oil tank, shall be enclosed in a factory assembled, sound attenuated enclosure mounted on the fuel tank base.
   1. A weather resistant, sound attenuated enclosure of 14-gauge Aluminum 5052 grade with electrostatically applied powder coated baked polyester paint. The enclosure shall have a resulting sound level of 70 dba at 23 feet with the genset running under full load. It shall consist of a roof, side walls, and end walls. Fasteners shall be stainless steel.

   2. Enclosure Sound Attenuation: Critical grade silencer. Acoustical foam shall be provided between all supports and inside doors and sound baffles on air intake and air discharge.

   3. Provide key-lockable access doors and externally mounted emergency stop button.

   4. Refer to the Drawings for dimensional requirements.

2.09 FUEL SYSTEM

A. Fuel system shall include replaceable primary and secondary filters, a fuel-control unit, and engine-driven fuel pump capable of a 5-foot lift plus friction on its suction side and of producing the required discharge pressure with a fuel supply check valve and flexible fuel connections.

B. Fuel Filters: Fuel system shall be equipped with fuel filters having replaceable elements which may be removed easily from their housing for replacing without breaking any fuel line connections or disturbing the fuel pumps or any part of the engine. All fuel filters shall be located for convenient access.

C. Fuel Lines: Fuel lines, between injection pumps and valves, shall be of heavy seamless tubing; and, to prevent irregularity of fuel injection, and shall be of the same length for all cylinders.

D. Injection Pump and Valves: Injection pumps and injection valves shall be a type not requiring adjustment in service, and shall be capable of easy replacement by ordinary mechanics. Engine shall have a mechanical injection pump or pumps and a pressure-activated injection valve for each cylinder, any one of which shall be easily removed and replaced from parts stock. The fuel-injection pump or pumps shall be of the engine-driven, positive-action, constant-stroke type, lubricated by the engine oil. A means of controlling manifold pressure shall be provided.

E. Fuel Sub Base Tank: Provide a double wall stainless steel Type 304 sub-base tank constructed to meet all local codes and requirements. A fuel tank base capacity for 48-hour generator run time at full load shall be provided as an integral part of the enclosure. It shall be contained in a rupture basin with 110 percent capacity. The tank shall meet UL142 standards. A locking fill cap, a mechanical reading fuel level gauge, low fuel level alarm contact, and fuel tank rupture alarm contact shall be provided. Normal vent piping shall be external to the enclosure and terminate no less than 8 feet above top of tank and no less than 12 feet above finished grade. Interior tank surfaces shall be coated with a solvent based thin-film rust preventative.

2.10 COOLING SYSTEM

A. Engine shall be furnished with a cooling system having sufficient capacity for cooling the engine when it is delivering full-rated load in an ambient temperature not to exceed 120 degrees F.

B. Pumps: Engine shall be equipped with an engine-driven, centrifugal-type pump for circulating water through the engine jacket, cylinder heads and radiator.

C. Control: Engine shall be provided with thermostatic bypass valve placed in the jacket water outlet between the engine and the cooling source. This valve shall maintain the jacket water temperature as recommended by the engine manufacturer, under all load conditions.

D. Radiator: Engine shall be provided with a skid base mounted radiator, with fan guard and core guard, of a type and capacity as recommended by the engine manufacturer. Provide flexible duct sections to connect radiator exhaust air to sheet metal ductwork.

E. Anti-Freeze: The engine cooling system shall be filled with solution of 50 percent ethylene glycol.

2.11 LUBRICATION

A. Engine shall have a forced-feed lubrication system. The lube oil system shall include a sump of not less than 3 gallons capacity, a dipstick and drain. The sump vent shall not require external plumbing.

B. The lube-oil pump shall be of the gear-type, engine-driven, and shall supply oil under pressure to main bearings, crank-pin bearings, pistons, piston pins, timing gears, camshaft bearings and valve rocker mechanism, and all other internal moving contact surfaces of metal.

C. The lubrication system shall be an integral part of the engine-reduction assembly, shall be air-cooled, or water cooled, but shall require no external plumbing or radiators.

D. Effective lubricating oil filters shall be provided and so located and connected that lubricating oil is continuously filtered and cleaned. Filter shall be accessible, easily removed and cleaned and shall be equipped with a spring-loaded bypass valve as an insurance against stoppage of lubricating oil circulation in the event the filter becomes clogged.

E. Engine shall have a suitable lubrication oil cooler, either air-cooled or water-cooled to ensure proper performance and engine life. The submission for approval shall state size and capacity of the lube oil cooler as well as the inlet and outlet temperature.

2.12 EXHAUST SYSTEM

A. Verification of the ability to meet emission specifications shall be made available from the engine manufacturer.

2.13 SAFETY CONTROLS, GAUGES, AND ALARMS

A. The engine shall be equipped with automatic safety controls which will shut down the engine in the event of low lubrication oil pressure, high water temperature, overcranking and overspeed.

B. The engine shall be equipped with an automatic safety control which shall actuate a visible alarm in the event of approached low oil pressure, high water temperature, and overspeed with dry contacts for remote alarms wired to terminal strips.

C. The engine shall be equipped with the following panel-mounted gauges: Jacket water temperature, lubricating oil pressure, fuel pressure, service meter (hour meter), and tachometer, etc.

2.14 SHOP INSTALLATION

A. Contractor shall furnish all necessary labor, material, and equipment required for complete installation and integration, including, but not limited to, the following:
   1. Diesel Generator: Install the diesel generator to set with base spring-type vibration isolator and neoprene acoustical pads, leveling devices, vertical and horizontal limit stops, approved by the set manufacturer.

   2. Diesel Generator Cooling System: Contractor shall provide final connection of radiator exhaust duct to radiator using 4-inch flexible neoprene fabric connection.

   3. Generator Starting System: Install the battery, battery rack and battery charger in accordance with battery and charger vendor's instruction manual. Provide all wirings for the entire starting system including engine starting cable between the battery system and diesel-generator per engine starting requirement. All cables shall be copper.

   4. Local Control Panel: Panel shall be installed, wired, and tested at equipment supplier's shop. Interconnections to equipment/ devices inside the enclosure shall enter the cabinet from the top of the cabinet. Outgoing power/control wirings to branch circuit panelboard, ATS, etc. shall enter the control cabinet from the bottom.

   5. Identification: All wire shall be clearly tagged with wire markers to indicate its origin and the circuit it feeds. Tags on the panels shall be of 1/16-inch thick by 3/4-inch wide, by 3 inches long with contrasting engraved lettering. Signal and control wiring shall be identified by means of labels, which shall indicate the panel letter and circuit number from where it originates. Provide a one-

inch by 3-inch (minimum) engraved Bakelite designation plate for all panels. All plates and labels shall be black with white lettering unless indicated otherwise. Provide engraved Bakelite designation plates for all separately mounted breakers, control relays, pilot light meters, etc. in control panels. Plates are to conform to the above requirements and indicate the equipment served. Bakelite designation plates shall be fastened to the aforementioned equipment with oval head brass machine screws. The minimum letter size shall be 1/4-inch high.

2.15 PAINT AND SPARES

A. The manufacturer's standard practice of (2 coats) shop priming and painting shall be used. All equipment shall be free from rust, scale, manufacturing residue and foreign material prior to painting. One gallon of touch-up paint shall be provided.

B. One set of spare oil, fuel, and air filters shall be provided in a non-metallic locking container.

2.16 SUPPORTS AND MISCELLANEOUS

A. The complete assembled engine-generator set will be field installed on a concrete equipment pad. Anchor bolts and templates for the assembly shall be furnished by the vendor 2 weeks after drawing approval. Disassembly of generator, engine and skid base will be permitted to facilitate installation.

B. The isolation system shall reduce the vibration transmitted to the adjacent floor slab by 95 percent or better. The manufacturer shall certify that the vibration isolation system will reduce the vibration to the limits specified.

C. Provide 120 VAC space heater. Heater capacity shall be as recommended by the generator manufacturer to aid in keeping generator insulation dry.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall conform to the applicable requirements of IEEE C2, NFPA 30, NFPA 37, and NFPA 70.

3.02 START-UP SERVICE

A. Contractor shall include in his bid the service of the vendor’s system/service engineer who fully understands the entire assembly/integration of the system, to assist in final piping/wiring checkout and to perform load and operational tests.

B. The bid shall include 3 complete days of service plus all out-of-pocket expenses. In the case of an unsatisfactory test result, vendor shall provide all parts and labor to repair the system and to continue the start-up and test procedure until the systems operation proved meeting the specification at no extra cost to the project. Resistive load banks shall be used to provide testing at the rated 1.00 power factor.

3.03 PREREQUISITES FOR CHECK OUT AND ACCEPTANCE TESTING

A. Completion of the following requirements is mandatory prior to scheduling for acceptance tests for the engine-generator set and auxiliary equipment.

B. Preliminary Operations: The vendor's system/service engineer shall conduct manufacturer recommended start-up procedures and tests to verify that the engine-generator set and auxiliary equipment are ready for functional acceptance tests. Give the Engineer 10 working days advance notice that preliminary operations will be conducted. After preliminary operation has been successfully conducted, the vendor's system/service engineer will notify the Engineer in writing stating the engine-generator set and auxiliary equipment are ready for acceptance tests.

C. Checkout and Acceptance Test Procedure: Test procedure shall be prepared by the vendor's system/service engineer specifically for the engine-generator set and auxiliary equipment. The test agenda shall cover the requirements specified in item entitled "CHECK OUT AND ACCEPTANCE TESTING" hereinbelow. The test procedure shall indicate in detail how tests are to be conducted. A statement of the tests that are to be performed without indicating how the tests are to be performed is not acceptable. Indicate what work is planned on each workday and identify the calendar dates of the planned workdays. Specify what additional technical support personnel is needed, such as factory representatives for major equipment. Specify on which testing workday each technical support personnel is needed. Data recording forms to be used to document test results are to be submitted with the proposed test procedure. A list of test equipment and instruments shall also be included in the test procedure.

D. Test Equipment: Test equipment and instruments shall be on hand prior to scheduling field tests or, subject to Engineer approval, evidence shall be provided to show that arrangements have been made to have the necessary equipment and instruments on site prior to field testing.

E. Coordinate check out and acceptance tests with the requirements of SECTION 16262 - AUTOMATIC TRANSFER SWITCHES.

3.04 CHECK OUT AND ACCEPTANCE TESTING

A. The equipment included in this specification shall be tested and assembled in accordance with the rules of the ANSI, IEEE, and NEMA when applicable. Tests shall simulate typical operating conditions.

B. An on-site test hereby specified, for the generator set and associated subsystem shall be conducted in the presence of the Engineer or his representative. Written notice shall be given to Engineer at least 10 working days in advance of testing.

C. Certified test log of engine-generator set showing the following data taken at and within specified parameters and 0.8 power factor. On-site resistive and reactive load banks shall be used to provide testing at the rated 0.80 power factor.
   1. Operate generator continuously under the following load conditions:
      a. 50 percent load - 2 hours

      b. 75 percent load - 2 hours

c. 100 percent load - 2 hours

2. Four repetitive 5-minute cycles of one-step application and removal of full load.

3. Voltage and frequency readings taken during test to be permanently recorded by chart recorded or light beam oscillograph of sufficient response and resolution to verify generator output characteristics specified.

4. Time lag from normal power failure to operation at rated voltage and frequency with no load and 100 percent load.

5. Half Hourly Log: Fuel consumption and water and exhaust gas temperatures.

6. Statement indicating accessories and auxiliaries used, ambient temperature, elevation and location.

D. A complete operational test shall be made including generator, fuel system, cooling system, protection and alarming system, etc. All interlocks and protective features shall be checked out.

E. If the system fails to meet the tests specified, then any additional tests required shall be made at no expense to the State.

F. Contractor shall provide loadbank with power factor adjustment capability, fuel, and required accessories and instruments, and other consumable products for all tests at no additional cost to the State.

G. Base fuel tank shall be completely filled, at the Contractor's cost, upon completion of all on-site testing.

3.05 EXTENDED OPERATIONAL TESTING AND MAINTENANCE SERVICE

A. Extended maintenance service work shall be provided by the Contractor for a one-year period from project acceptance. All materials, equipment, and labor to perform the prescribed maintenance shall be included in the Bid.

B. The Contractor shall include in his bid the service of the vendor's authorized field service engineer and/or mechanic to provide quarterly and one-year maintenance interval work as outlined below. Service work performed shall include the listed items in addition to any recommended work identified in the operations and maintenance manual for the equipment.

C. Quarterly Service Requirements:
1. Before Starting the Engine:
a. Perform all "Weekly Before Starting the Engine Maintenance" procedures per Operations and Maintenance Manual first.

b. Walk-Around Inspection: Inspect engine, radiator and generator for debris, loose or broken fittings, hoses or wires and guards. Repair as necessary.

c. Cooling System: Check coolant level. Maintain level within 1/2 inch to bottom of filler neck or proper level on sight gauge (if equipped). Replace coolant element (if equipped) or add liquid coolant conditioner.

d. Fuel System: Drain water and sediment from tank. Change fuel filters.

e. Air Cleaner Element: Inspect and clean or replace element.

f. Governor: Check and maintain oil level (if required).

g. Engine Crankcase: Check oil level. Maintain oil level between the ADD and FULL marks on the "Engine Stopped" side of the dipstick.

h. Crankcase Breather: Clean.

i. Linkages: Check and adjust all linkages, if necessary. Lubricate all linkage fittings with MPGM grease.

j. Engine Protective Devices: Check; test for proper operation.

k. Batteries: Clean top of batteries. Check electrolyte level (unless maintenance free). Check for loose connections.

l. Engine: Wipe down; clean as needed.

m. Generator: Check for moisture, dust, oils, greases and debris on main stator windings, exciter and PMG. Clean as needed. Check generator windings with megohmmeter and record readings for reference.

n. Generator Bearing: Inspect generator bearing and bracket. Lubricate generator bearing.

2. With Engine Running:
   a. Perform all "Weekly with Engine Running Maintenance" procedures per Operation and Maintenance Manual first.

   b. Start the Engine: Operate the engine and check all gauges, oil pressure, fuel pressure, rpm (frequency), generated voltage and engine jacket water temperature, for correct readings.

   c. Engine Crankcase: Check the oil level. Maintain the oil level between the ADD and FULL marks on the "Engine Running" side of the dipstick.

   d. Generator Louvers: Check for proper operation (able to open and close freely).

   e. Generator Air Inlet Filter (If Equipped): If differential pressure exceeds 0.6 inches of water, stop the engine and clean the elements by soaking in hot water with detergent. Rinse with clear water. Recharge the elements with a thin layer of lightweight machine oil (WD-40 or equivalent).

f. Engine Mounts: Inspect for proper installation and loose fasteners. Check for proper torque.

g. Leaks and Noises: Check for leaks and unusual noises. NOTE: Engine must be stopped before making necessary repairs.

3. After Stopping the Engine:
   a. Perform all "Weekly After Stopping the Engine Maintenance" procedures per Operation and Maintenance Manual first.

   b. Walk-Around Inspection: Repair or adjust. Make repairs or adjustments to the engine and generator set as necessary. Report any malfunction and make necessary repairs.

   c. Scheduled Oil Sampling (SOS): Obtain sample for analysis.

   d. Generator Air Inlet Filter (If Equipped): Remove the filter elements and soak in hot water with detergent until clean. Rinse with clear water. Recharge the elements with a thin layer of lightweight machine oil (WD-40 or equivalent).

   e. Battery Charger: Record charging amperage and volting readings.

   f. Automatic Switches (If Equipped): Check that all switches are in proper position for automatic start.

   g. Base fuel tank shall be completely filled, at the Contractor's cost, upon completion of quarterly maintenance procedures.

D. One-Year Service Requirements:
   1. Before Starting the Engine:
      a. Perform all Quarterly Maintenance Procedures described above.

      b. Valve Lash: Check, adjust if necessary. Refer to the engine Service Manual for proper procedure and settings.

   2. With Engine Running:
      a. Perform all Quarterly Maintenance Procedures described above.

      b. Load Test: Load the engine to minimum of 30 percent of rated load using building load. Operate at this level for minimum of 2 hours. After approximately one hour, record the readings of all gauges: oil pressure, fuel pressure, oil level rpm (frequency), generated voltage, service meter and engine jacket water temperature.

   3. After Stopping the Engine:
      a. Perform all Quarterly Maintenance Procedures described above.

      b. Engine Oil and Filter(s): Change oil. Replace filter(s), cut old filter open and inspect for foreign material.

3.06 TRAINING COURSE

A. The Contractor shall conduct an on-site training course for operating staff and maintenance personnel as designated by the State.

B. The training period shall consist of a total of 8 hours of normal working time.

C. The initial training sessions shall be 4 hours in duration and shall start after the system is functionally completed but prior to final acceptance tests.

D. The remaining 4 hours of instructional time shall be scheduled at the discretion of the State within one year of initial operation and acceptance of the equipment.

E. Training shall concentrate on operation, maintenance, and troubleshooting procedures of the installed system.

END OF SECTION

SECTION 16262 - AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.01 SUMMARY
A. Provide automatic transfer switch for standby power distribution system.

1.02 RELATED WORK
A. SECTION 16011 - GENERAL ELECTRICAL REQUIREMENTS applies to this section with additions and modifications as specified herein.

B. SECTION 16100 - ELECTRICAL WORK applies to this section with additions and modifications as specified herein.

C. SECTION 16208 - ENGINE GENERATOR SET applies to this section with additions and modifications as specified herein.

1.03 STANDARDS AND CODES
A. The equipment covered by this specification shall be designed, tested and assembled in accordance with the applicable standards of ASTM, ANSI, IEEE and NEMA, as minimum requirements for all items.

B. The equipment shall comply with NEC, OSHA and all pertinent Federal and Local Codes, regulations and ordinances, including UL approval.

1.04 SUBMITTALS
A. Submit in accordance with SECTION 01330 - SUBMITTAL PROCEDURES.

B. Submit catalog data for the automatic transfer switch. Provide complete product specifications of all equipment including outline drawings showing approximate dimensions, weights and complete performance data.

C. A statement is required that the equipment to be furnished will be in accordance with this specification. Any exceptions to it must be listed in detail.

D. Shop Drawings:
   1. System configuration with single-line/three-line diagram showing all components, detailed layouts of all metering, alarm and mimic panels.

   2. Front elevation, sections showing equipment and buswork, relays, fuses, etc. and cable lug quantities, sizes and location, and any information required for complete identification and location.

   3. Floor plan showing materials, sizes, anchoring, location of power and control conduit entries above and below.

   4. Performance characteristics including time-current curves for all overcurrent protective devices such as fuses, overload relays, etc.

5. Schematic and wiring diagrams of all power, control, monitoring, metering and any other circuits.

6. Wiring diagrams showing interconnections among automatic transfer switch, utility power, generator, etc.

E. Terminal block and lug numbers for all external connections shall be the same as shown on the elementary diagrams and shall be identified in a manner to distinguish them from internal interconnecting points.

F. Seismic Qualification Certification:
   1. Submit certification that the automatic transfer switch will withstand seismic forces as required for the site conditions. Seismic certification shall be third-party certified and based on testing.

   2. Dimensioned Outline Drawings of Equipment: Identify center of gravity and locate and describe mounting and anchorage provisions.

   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

G. Operating Instructions: Submit operating instructions as stipulated in item entitled “OPERATING INSTRUCTIONS” hereinbelow.

H. Warranty: Submit warranty as stipulated in item entitled “WARRANTY” hereinbelow.

I. Maintenance Service Contract: Submit maintenance service contract as stipulated in item entitled “MAINTENANCE SERVICE CONTRACT” hereinbelow.

1.05 OPERATING INSTRUCTIONS

A. Submit in accordance with SECTION 01770 - CLOSEOUT PROCEDURES. The instruction book shall include the following:
   1. Operating instructions and maintenance procedures for all components.

   2. Recommended spare parts list containing information of components, manufacturer’s name and catalog number.

   3. Approved and certified shop drawings.

   4. Test results.

B. Four sets of instruction books shall accompany the equipment.

1.06 PROTECTION

A. All material, equipment and component parts shall be adequately protected to prevent corrosion or entry of foreign matter during shipment, during storage in an unheated indoor dusty atmosphere and damage during shipment. The Contractor shall make good at his own expense, all damage due to improper preparation and/or storage of equipment and component parts.

1.07 WARRANTY

A. The Contractor shall warranty all equipment which he furnishes for a period of one year from the date of successfully completed final acceptance testing of the standby power system, including generator equipment.

B. The Contractor shall promptly correct any deficiencies in the equipment he furnished which occur during the warranty period at the site at no additional cost to the State. This shall include all costs for material and labor.

1.08 MAINTENANCE SERVICE CONTRACT

A. The Contractor shall provide extended testing and maintenance services for the engine generator system for a period of one year from the date of final project acceptance.

B. The Contractor shall include all material, equipment and labor costs for performing maintenance work in his Bid.

PART 2 - PRODUCTS

2.01 MANUFACTURERS AND MATERIALS

A. The switches and all major items of auxiliary equipment shall be manufactured in the U.S. by manufacturers currently engaged in the production of such equipment. The unit shall be factory assembled, and tested by the manufacturer and shipped to the job site by his authorized dealer having a parts and service facility in the area. ASCO, Russelectric, Caterpillar, or accepted equivalent. Circuit breaker switches are not acceptable.

B. All materials, equipment, and parts comprising the units specified herein, shall be new and unused, of current manufacture and of highest grade.

C. All automatic transfer switches (ATS) in the project shall be the product of one manufacturer and be completely factory assembled and tested as a single unit. ATS shall be mounted in a front accessible only enclosure. The interconnections shall be bussed or cabled by the manufacturer so that the Contractor will be required to make only the power connections to complete the installation.

2.02 RATING

A. The automatic transfer switch shall be rated for continuous duty at the indicated amperes, 3-poles, for normal and emergency source of the 208/120 volts, 3-phase, 4-wire, 60 Hertz with minimum withstand current rating and continuous current rating as indicated.

2.03 AUTOMATIC TRANSFER SWITCH

A. The ATS shall detect a power failure automatically and trigger controls to start an engine generator set. When generator reaches proper voltage and frequency, the switch then transfers loads from normal power to generator. When the normal source is ready to supply power again, the ATS senses it and retransfers the load back to the normal source and triggers the control to shut down the engine generator.

B. ATS shall include, but is not limited to the following features:
   1. Selective normal switch mounted on enclosure door to select either source to be considered as the normal
   2. Mechanically held, electrically operated.
   3. Single solenoid operating mechanism.
   4. Contacts shall be readily accessible for easy inspection and maintenance.
   5. Silver-plated copper bus.
   6. In-phase controls for transfer and retransfer.
   7. One second time delay on transfer.
   8. Adjustable time delay (0-30 minutes) on re-transfer, preset at 5 minutes.
   9. Auxiliary contacts (N.C. and N.O.) For engine start, gold plated, rated 25 amperes, 48 volts DC.
   10. Close differential relays and transfer control relay to measure normal source voltage. Set to drop out at 83-85 percent, pick-up at 92-95 percent frequency.
   11. Emergency source voltage and frequency sensing relay, set to pickup at 90 percent voltage, 95 percent frequency.
   12. Auxiliary contacts at ATS failure for remote indication.
   13. Test switch to simulate power failure.
   14. Unload running time relay for emergency generator cool-down, adjustable from 0-5 minutes, factory set at 5 minutes.
   15. Auxiliary contacts of normal and emergency position for remote indication and control interfaces with other systems.
   16. Pilot lights on hinged door for normal and remote indication.

2.04 COMMUNICATIONS NETWORK

A. Control panel shall include ModBus Ethernet output card.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall conform to the requirements of the NFPA 70 and manufacturer's recommendations.

3.02 PREREQUISITES FOR FUNCTIONAL ACCEPTANCE TESTING

A. Completion of the following requirements is mandatory prior to scheduling functional acceptance tests for the automatic transfer switch.

B. Performance of Acceptance Checks and Tests: Complete as specified in paragraph entitled "Acceptance Checks and Tests" hereinbelow.

C. Test Equipment: All test equipment and instruments shall be on hand prior to scheduling field tests, or subject to Engineer's approval, evidence shall be provided to show that arrangements have been made to have the necessary equipment and instruments on site prior to field testing.

3.03 FIELD QUALITY CONTROL

A. Give Engineer 10 working day advance notice of dates and times scheduled for tests which require the presence of the Engineer. The Engineer will coordinate with the using agency and schedule a time that will eliminate or minimize interruptions and interference with the activity operations. The contractor shall be responsible for costs associated with conducting tests outside of normal working hours and with incorporating special arrangements and procedures, including temporary power conditions. The contractor shall provide labor, equipment, apparatus, including test load, and consumables required for the specified tests. Calibration of all measuring devices and indicating devices shall be certified. Perform the following field tests in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

B. Acceptance Checks and Tests:
   1. Visual and Mechanical Inspection:
      a. Compare equipment nameplate data with specifications and approved shop drawings.

      b. Inspect physical and mechanical condition.

      c. Confirm correct application of manufacturer's recommended lubricants.

      d. Verify that manual transfer warnings are attached and visible.

      e. Verify tightness of all control connections.

      f. Verify tightness of accessible bolted connections by calibrated torque-wrench method. Thermographic survey is not required.

      g. Perform manual transfer operation.

      h. Verify positive mechanical interlocking between normal and alternate sources.

   2. Electrical Tests:
      a. Measure contact-resistance.

b. Perform insulation-resistance on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole for one minute. Perform tests in both source positions.

c. Verify settings and operations of control devices.

d. Calibrate and set all relays and timers.

C. Functional Acceptance Tests: Shall include simulating power failure and demonstrating the following operations for each automatic transfer switch. Contractor shall show by demonstration in service that the automatic transfer switches are in good operating condition, and function not less than 5 times.

1. Coordinate acceptance tests with the requirements of SECTION 16208 – ENGINE GENERATOR SET.

2. Perform Automatic Transfer Tests:
   a. Simulate loss of normal/preferred power.

   b. Return to normal/preferred power.

   c. Simulate loss of emergency power.

   d. Simulate all forms of single-phase conditions.

3. Verify correct operational and timing of the following functions:
   a. Normal source voltage-sensing relays.

   b. Engine start sequence.

   c. Time delay upon transfer.

   d. Alternate source voltage-sensing relays.

   e. Automatic transfer operation.

   f. Interlocks and limit switch function.

   g. Time delay and retransfer upon normal power restoration.

3.04 EXTENDED OPERATIONAL TESTING AND MAINTENANCE SERVICE

A. Extended operational testing and maintenance service work shall be provided by the Contractor for a one-year period from project acceptance. All materials, equipment, and labor to perform the prescribed testing and maintenance shall be included in the Bid.

B. The Contractor shall include in his bid the service of vendor's authorized field service technician to provide monthly and one-year testing and maintenance interval work as outlined below. Work performed shall include the listed items in addition to any recommended work identified in the Operations and Maintenance Manual for the equipment. Coordinate all services with operational testing and maintenance work associated with the engine-generator set.

C. Monthly Requirements:
   1. Perform all monthly testing and maintenance procedures per Operations and Maintenance Manual.

   2. Electrically operate the transfer switch from the standard (normal power) position to the alternate (emergency power) position and then a return to the standard position.

D. One-Year Requirement:
   1. Perform all monthly testing and maintenance procedures as described above.

   2. Clean and inspect ATS enclosure.

   3. Inspect transfer switch contacts. Replace pitted or worn contacts.

   4. Maintain transfer switch lubrication.

   5. Inspect all cable connections and retighten if necessary.

3.05 TRAINING COURSE

A. The Contractor shall conduct an on-site training course for operating staff and maintenance personnel as designated by the State.

B. The training period shall consist of a total of 4 hours of normal working time.

C. The initial training sessions shall be 2 hours in duration and shall start after the system is functionally completed but prior to final acceptance tests.

D. The remaining 2 hours of instruction time shall be scheduled at the discretion of the State within 2 years of initial operation and acceptance of the equipment.

E. Training shall concentrate on operation, maintenance, and troubleshooting procedures of the installed system.

END OF SECTION

SECTION 16301 - UNDERGROUND ELECTRICAL WORK

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes, but not limited to, underground electrical distribution system.

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. SECTION 16011 - GENERAL ELECTRICAL REQUIREMENTS applies to this section with additions and modifications specified herein.

1.03 APPLICABLE PUBLICATIONS

A. The publications cited within this specification form a part of this specification to the extent referenced. Unless otherwise indicated, most recent edition of the publication with current revisions and amendments will be enforced.

1.04 SUBMITTALS

A. Submit in accordance with SECTION 01330 - SUBMITTAL PROCEDURES.

B. Manufacturer's Data and Shop Drawings: Warning tape.

C. Test Reports: Submit test reports as stipulated in item entitled “FIELD TESTS” hereinbelow.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment shall conform to the respective specifications and standards and to the specifications herein. Electrical ratings shall be as indicated.
   1. Rigid Plastic Conduit: UL 651, Schedule 40, PVC.

   2. PVC Fittings: UL 651.

   3. Tape: UL 510. Plastic insulating tape shall be capable of performing in a continuous temperature environment of 80 degrees C.

   4. Power Wire and Cable:
      a. Wire and cable conductor sizes are designated by American Wire Gauge (AWG).

      b. Conductors shall be copper. Insulated conductors shall bear the date of manufacture imprinted on the wire insulation with other identification. Wire and cable manufactured more than 6 months before delivery to the job site shall not be used.

c. Provide conductor identification within each enclosure where a tap, a splice or a termination is made.

d. Use No. 10 minimum sized conductors, unless otherwise noted.

5. Wire Conformation: Cables shall be type XHHW-2 conforming to NEMA WC-7 and UL 44 or type USE conforming to NEMA WC-7 and UL 854.

6. Connector and Terminals: Wire connectors and terminals for use with copper conductors shall conform to UL 486A.

7. Grounding and Bonding Equipment: Shall conform to UL 467.

8. Warning Tape: Pre-printed polyethylene, 4-mil minimum thick, 3 inches minimum width, detectable foil backed, color-coded.

9. Duct Seal: Pliable, non-toxic material used for application around conductors in raceway and in empty conduits to minimize moisture and rodent/insect infiltration. Must be re-enterable material allowing for removal/reapplication after initial installation. Non-drying, non-cracking, non-corrosive material that will not adversely affect raceway and conductors. Provide duct seal at all duct entries in handholes, apparatus, and risers to prevent water infiltration via duct system.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Underground cable installation shall conform to NFPA 70 and ANSI C2.
   1. Concrete: Concrete for electrical requirements shall be at least 2500 psi concrete with one-inch maximum aggregate conforming to the requirements of DIVISION 3 - CONCRETE.

   2. Earthwork: Excavation, backfilling, and pavement for repairs for electrical requirements shall conform to the requirements of DIVISION 2 - SITE CONSTRUCTION.

   3. Underground Duct with Concrete Encasement: Construct underground duct lines of individual conduits encased in concrete. The conduit shall be of PVC. The concrete encasement surrounding the bank shall be rectangular in cross-section and shall provide at least 3 inches of concrete cover for ducts. Separate conduits by a minimum concrete thickness of 2 inches, except separate light and power conduits from control, signal, and telephone conduits by a minimum concrete thickness of 3 inches.
      a. 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. Except at conduit risers, accomplish changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, by long sweep bends having a minimum radius of curvature of 25 feet. Sweep bends may be made up of one or more curved or straight sections or combinations thereof. Manufactured bends shall have a minimum radius

of 18 inches for use with conduits of less than 3 inches in diameter and a minimum radius of 36 inches for ducts of 3 inches in diameter and larger.

b. 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. During construction, protect partially completed duct lines from the entrance of debris such as mud, sand and dirt by means of suitable conduit plugs. As each section of duct line is completed from handhole to handhole, draw a brush through having the same diameter of the duct, and having stiff bristles until the conduit is clear of all particles of earth, sand, and gravel; then immediately install conduit plugs.

4. Cable Pulling: Pull cables down grade with the feed-in point at the handhole or buildings of the highest elevation. Use flexible cable feeds to convey cables through the handhole opening and into the duct runs. Cable slack shall be accumulated at each handhole or junction box where space permits by training the cable around the interior to form one complete loop. Minimum allowable bending radii shall be maintained in forming such loops.
   a. Lubricants for assisting in the pulling of jacketed cables shall be those specifically recommended by the cable manufacturer. The lubricant shall not be deleterious to the cable sheath, jacket, or outer coverings.

   b. Cable pulling tensions shall not exceed the maximum pulling tension recommended by the cable manufacturer.

   c. Secondary cable runs, 600 volts and less, shall include an insulated copper equipment grounding conductor sized as indicated.

   d. Installation of Cables in Handholes: Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths. Form all cables to closely parallel walls and not to interfere with duct entrances. In existing handholes where new cables are to be installed, modify the existing installation of cables, cable supports and grounding as required for a neat and workmanlike installation with all cables properly arranged and supported.

5. Cable Terminating: Protect terminations of insulated cables from accidental contact, deterioration of coverings and moisture by the use of terminating devices and materials. Install all terminations of insulated cables and cable splices in accordance with the manufacturer's requirements. Make terminations using materials and methods as indicated or specified herein or as designated by the written instructions of the cable manufacturer and termination kit manufacturer.
   a. Splices for 600 Volt Class Cables: Make splices in underground systems only in accessible locations such as handholes, using a compression connector on the conductor and by insulating and waterproofing by one of the following methods suitable for continuous submersion in water.
      1) Provide cast-type splice insulation by means of molded casting process employing a thermosetting epoxy resin insulating material and apply by a gravity poured method or by a pressure injected

method. The component materials of the resin insulation shall be in a packaged form ready for convenient mixing without removing from the package. Do not allow the cables to be removed until after the splicing material has completely set.

2) Gravity poured method shall employ materials and equipment contained in an approved commercial splicing kit which includes a mold suitable for cables to be spliced. When the mold is in place around the joined conductors, prepare the resin mix and pour into the mold. Do not allow cables to be moved until after the splicing materials have completely set.

3) Heat Shrinkable method shall employ materials and equipment contained in an approved commercial splicing kit.

6. Grounding:
   a. Grounding electrodes shall be cone pointed driven ground rods driven full depth less 6 inches, installed when indicated to provide an earth ground of the value before stated for the particular equipment being grounded.

   b. Make grounding connections which are buried or otherwise normally inaccessible and excepting specifically those connections for which access for periodic testing is required by exothermite type process. Make thermit welds strictly in accordance with the weld manufacturer's written recommendations. Welds which have "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. No mechanical connector is required at thermit weldments.

   c. In lieu of an exothermic type process, a compression ground grid connector of a type which uses hydraulic compression tool to provide the correct circumferential pressure may be used. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other standard method shall provide visible indication that a connector has been adequately compressed on the ground wire.

   d. Grounding conductors shall be bare soft-drawn copper wire No. 6 AWG minimum unless otherwise indicated or specified.

3.02 UNDERGROUND FEEDER IDENTIFICATION

A. Cables shall be labeled at both ends and in handholes in the following format: X-Y-POWER where “X” represents the source building, “Y” represents the destination building and “POWER” represents Power cable.

3.03 FIELD TESTS

A. Distribution Conductors 600 Volt Class: Test all 600-volt class conductors #1/0 AWG and larger 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.

B. Ground Rods: Test ground rods for ground resistance value before any wire is connected. Use a portable ground testing megger to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground electrode under test. Provide one copy of the megger manufacturer's directions for use of the ground megger indicating the method to be used.

C. Test Report: Provide 3 copies of each test report to the Engineer.
   1. 600-volt cables (identify each cable and test result).

   2. Grounding Electrodes and Systems (identify electrodes and systems, each test).

END OF SECTION