GUAM POWER AUTHORITY

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January 22, 2019

AMENDMENT NO.: X

INVITATION FOR MULTI-STEP BID NO.: GPA-034-18

FOR

BUILD, OPERATE & TRANSFER CONTRACT FOR 180MW OF NEW GENERATION CAPACITY
STEP 2 – TECHNICAL SPECIFICATIONS

Step 1 Qualified Bidders are hereby notified of the following responses to inquiries received from the following:

Qualified Bidder #5 dated 11/20/2018:

QUESTION:

1. Gray water & Potable water Spec
   Please provide Temperature and TDS (Total Dissolved Solids) of Gray water.

   Please provide below parameters of Potable water

   - Total Dissolved Solids (mg/L)
   - Total Suspended Solid (mg/L)
   - Reactive silica (mg/L)
   - Non-reactive silica (mg/L)
   - Total Silica (mg/L)
   - Free CO2 (mg/L)
   - Sodium ion (mg/L)
   - Magnesium ion (mg/L)
   - Potassium ion (mg/L)
   - Aluminum ion (mg/L)
   - Fe3+ (mg/L)
   - Fe2+ (mg/L)
   - Bicarbonate Ion (mg/L)
   - Carbonate Ion (mg/L)
   - Chlorine (mg/L)

ANSWER:

a. The analysis provided with bid documents is all that is currently available. Contract GWA directly for more details.

b. Contact GWA directly for potable water analysis.

QUESTION:

2. Gray water & Potable water Spec
   Section C
   Appendices
   Appendix A: Grey Water Quantity and Analysis ~ Appendix E: Raw Water Analysis
   Section C, Clause 1.3.3, Page Numbers 92 & 102
   1.3.3 Water Supply
   Water supply to the Facility will be the responsibility of the Project Company. It is preferred that the raw water for cycle makeup, as well as for potable water will be supplied from Guam Water Authority. Guam Water Authority (GWA) will supply grey water to the plant from the nearby Northern District Wastewater Treatment Plant (NDWWTP) to be used for cycle cooling water system if required. Available quantity and analysis of the grey water is included in Appendix A. The Project Company shall be responsible for determining the water treatment requirements for the water sources. The grey water supply interface point will be at NDWWTP. The precise location of the terminal point will be determined by the Selected Project Company at the detailed design stage.
   There will be no sea water makeup utilized.

   According to RFP, Bidder can receive the Raw water and potable water separately for plant internal consumer from GWA (Guam Water Authority).
   Also Bidder can receive the Grey water.

   Can Bidder receive the below information for each water source (Raw water, Potable water & Grey water)'s information as follows?
   1. Quantity limitation: How much water can be provided for Plant?
   2. Condition: Pressure, Temperature at Terminal point are required.
   3. Terminal point location: Bidder want to know tapping point.

ANSWER:

1. GWA is permitted for up to six million gallons per day grey water discharge
2. Contact GWA directly for raw water and potable water available quantities
3. Contact GWA directly for pressure temperature at terminal point
4. Contact GWA directly for nearest source of supply

QUESTION:

3. Gray water & Potable water
   Section C, Clause 1.3.4, Page Number 103
   1.3.4 Wastewater Discharge
   Wastewater discharge will be the responsibility of the Project Company. The Project Company will need to determine wastewater pretreatment quality to meet the requirements of GWA.
   Sanitary sewer may potentially be discharged to the GWA treatment facility. The Project Company shall be responsible for the wastewater discharge permitting, and any contractual agreements with GWA.

   Regarding the Waste water discharge, please check Bidder's question as follows.
   1. How much waste water can be discharged to GWA treatment facility?
   2. Can Bidder receive the GWA's requirement for Waste water quality?

ANSWER:

1. Coordinate question with GWA.

2. Coordinate question with GWA.

QUESTION:

4. Scope of Investigation for explosive and national historic and cultural properties
   Section C, Clause 1.2.5, Page Number 95
   Detailed Project Scope

   It is expected to execute an investigation for explosive and national historic and cultural properties prior to construction work (Plant area & Fuel Pipe Line). Please clarify whose scope for those works.

ANSWER:

This scope will be completed by GPA.

QUESTION:

5. Water Supply from Guam Water Authority
   Section C, 1.3.3, Page Number 103
   Guam Water Authority (GWA) will supply grey water to the plant from the nearby Northern District Wastewater Treatment Plant (NDWWTP) to be used for cycle cooling water system if required.

   GWA has indicated that they intend to charge the Bidders for the treated effluent water that they can provide, but are not in a position to specify how much they intend to charge. If there is a charge for usage of effluent water, then this must be added in the financial model. Please provide a common pricing basis for all Bidders to consider for commercial proposals to ensure a fair comparison.

ANSWER:

Rates are published on the GWA website (http://guamwaterworsk.org/rates/).

QUESTION:

6. Minimum Efficiency Requirements
   Section C, 1.3.3, Page 103
   The fossil fuel plant net Heat Rate (Btu/kW-hr) is the heat input (Btu/hr) to the plant, divided by the plant net capacity (kW – net). The heat input is the higher heating value of fuel (Btu/lb) multiplied by the fuel flow rate (lb/hr). The plant will be evaluated based upon the least cost of operation to the GPA system. The target efficiency for the facility at base load is 45% or greater. The Project will be evaluated by its estimated cost of generation over the life of the plant (see IFB Sections B and D for details on evaluation methodology). The Project Company shall submit the Guaranteed Heat Rates at different loads as requested in Section D, Form 15.

   Please confirm our understanding that the 45% efficiency is on a HHV basis.

ANSWER:

Confirmed.

QUESTION:

7. Synchronous Condenser Capabilities
   Section C, 2.2.1, Page Number 106
   The plant shall be capable of providing a minimum level of 700 MVA of Short Circuit energy at the 115 kV POI when operating at 20 MW or higher real power output. This may require either dedicated synchronous condensers, or some of the generating units not producing real power in such a scenario to be able to operate as synchronous condensers or the provision of a separate energy storage system.

   Please advise on the availability (Capabilities) required of the "minimum level of 700 MVA of Short Circuit energy at the 115 kV POI when operating at 20 MW or higher real power output"

ANSWER:

The Synchronous condenser shall have availability of 90% or more.
Facility availability guarantee is considered in the evaluation model by assuming that the existing GPA plants will have to generate electricity during the time when the Facility is not available.

QUESTION:

8. RFO Pipeline demolition and ULSD Pipeline Installation
   Section C, Appendix B, 1.2, Page Number 194
   The ULSD pipeline is to be constructed, as much as is reasonably possible, in the existing 8" RFO pipeline easement. The existing 8" pipeline is no longer active and the Project Company is to remove and replace with the new ULSD pipeline.

   On page 96 of the RFP, it states that the bidder must "construct ULSD underground pipeline". Due to the fact that a large portion of the land is on military land, the bidder will need to follow MEC/UXO regulations which can drastically increase the construction cost if underground. Does GPA require that the pipeline be underground the entire route or will GPA allow aboveground pipeline for military land area? At minimum can the pipeline on military land be above ground while non-military land be placed above ground.

ANSWER:

Response shall be forthcoming.

QUESTION:

9. RFO Pipeline demolition and ULSD Pipeline Installation
   Section C, Appendix B, 1.2, Page 194
   The ULSD pipeline is to be constructed, as much as is reasonably possible, in the existing 8" RFO pipeline easement. The existing 8" pipeline is no longer active and the Project Company is to remove and replace with the new ULSD pipeline.

   Please specify the size of the new ULSD pipeline or if it is intended only for supply for the power plant.

ANSWER:

Project Company should determine the size of the new ULSD pipeline based on their power plant proposal. It is intended to supply the new bulk storage facilities where the power plant and plant site fuel truck loading facilities will receive their fuel from.

QUESTION:

10. ESA
    Amendment No. V, Qualified Bidder #5, dated 10/12/2018, No. 8, Page Number 7
    Bidder asked, "Has a Phase I ESA been completed for the proposed site? If you have, Please provide Phase I ESA Report"
    GPA responded, "If ESA means Endangered Species Act. Biological and archeological site surveys are currently in progress"

    Bidder would like to clarify our reference to "ESA" is "Environmental Site Assessment". Has a Phase 1 Environmental Site Assessment (ESA) or Phase II ESA been completed for the site? What is known about contamination on the site or along the project linears?

ANSWER:

ESA has not been conducted. Contamination is not known.

QUESTION:

11. Environmental Studies, Pre-Award
Section D, 8.10 Environmental Data, Page Number 466
Answer the questions below or attach a detailed environmental impact study that includes answers to at least the following questions

What type of detailed environmental impact study does GPA anticipate bidders would complete at this point in the bid process (prior to award of contract)?

Does GPA anticipate that National Environmental Protection Agency (NEPA) documentation would be needed for any of the federal permits?

ANSWER:

a. No environmental impact study is required prior to award of contract.

b. Response shall be forthcoming.

QUESTION:

12. Site Size and Layout
Section C, 5.3 Site Size and Layout, Page Number 164
Project Company will locate the plant on the property to maintain a vegetation barrier while preserving as much of the remaining acres for future development.

What type of future development does GPA anticipate on the site?

ANSWER:

Currently unknown. Primary objective of site is power generation.

QUESTION:

13. Biological and Archeological Surveys
    Amendment No. III, Qualified Bidder #5's additional site visit requests, Page Number 2
    Guam Power Authority (GPA) has contracted with third party companies to perform a plant site boundary survey, geotechnical borings, a biological survey and an archeological survey. The results will be available to bidders when completed.

    Please provide the scope of the biological and cultural resources studies currently being completed? Will the biological survey address wetlands and threatened and endangered species?

    Is the archeological survey a reconnaissance pedestrian survey or does it include a testing program?

    What is the geographic extent of both of these surveys? Does it address the site, transmission line, fuel, water, potential wastewater routes, or access road?

    Will these surveys identify mitigation needed to address potential impacts to these resources?

ANSWER:

a. The site is being surveyed for wetlands and endangered species as well as cultural artifacts.

b. A number of shovel test probes will be utilized.

c. The plant site only.

d. Currently not known.

QUESTION:

14. SCR
    Section D, 8.10 Environmental Data, Page Number 466
    Describe the technology to be used to maintain air emissions and air pollution within the specified guidelines

    Preliminary research indicates that the plant will require a major air permit application process with Prevention of Significant Deterioration (PSD) permits. The decision whether Selective Catalytic Reduction (SCR) qualifies as Best Available Control Technology (BACT) is dependent upon the regulation agency. Does GPA have experience with Guam EPA on this issue? Or, can GPA provide insight whether Guam EPA will consider SCR as BACT and therefore require SCR for this project?

ANSWER:

GPA believes that Guam EPA would not suggest what controls will need to be applied to stay within minor source classification but rather that the Bidder should determine what controls will be needed.

QUESTION:

15. Noise level
    Section C, 2.2.8, Page Number 108
    Noise level at the site boundary shall not exceed 45 dB(A), measured in the horizontal plane and at an elevation of 5 feet (1.5 meters) from grade with all equipment running at full capacity.

    During the pre-bid site visit, our consortium recorded the noise level via a handheld noise detector. The results of noise level measurement was 50~55 dB.

    Due to the pre-existing noise levels the 45 dB is too strict for any bidder to accomplish.

    Bidder Propose the noise level standard to be change to 55 dB or more.

ANSWER:

GPA is commissioning a background noise survey that will be provided to bidders by the end of January. The noise requirement will be adjusted to the World Bank Group International Finance Corporation EHS Guidelines - 1.7 Noise.pdf – see attached. Bidders must apply appropriate noise control methods to assure compliance.

QUESTION:

16. RFO Pipeline demolition and ULSD Pipeline Installation
    During the site visit, a large portion of the pipeline was not able to be visually inspected; namely Nimitiz Hill.

    Due to this restriction we would like to ask GPA to provide the exact length of the undergrounded and above ground pipes for that section? Ideally, as-built drawings of the pipeline would allow all bidders to correctly estimate the scope of work.

ANSWER:

Kindly refer to *INCLUSIONS* of Amendment No: VIII.

QUESTION:

17. Site Investigation
    It was stated in the pre-bid conference that GPA is currently working on archeological and biological investigation before starting the geotechnical work for the 16 boring test. Does this mean that the archeological and biological investigation will only be done on the 16 boring locations or will these be tested throughout the site?

ANSWER:

There are twelve (12) planned boring locations evenly spread throughout the site. Please see 127.05 - Appendix A.pdf for the test boring location plan, test boring logs, and soil classification system.

QUESTION:

18. Natural gas pipe line construction and test
    Section A, 1.1.5, Page Number 13
    Natural Gas Commercial Operation Date of the Facility will depend on the timing of development of the LNG infrastructure.

    According to RFP, Bidder has to install ULSD and NG pipe line to provide fuel for power plant. But we are expecting that LNG infrastructure may not be installed within a schedule and there might be no way to test NG pipe line without any NG in Guam. So, could GPA kindly provide NG provision schedule to test NG pipe line before completing pipe line and power plant construction?

ANSWER:

The timing of natural gas becoming available on Guam is currently not determined. The Bidder will have to construct and hydrotest the gas pipeline while it is not connected to the LNG facilities by putting blind flange at both ends to of the pipeline or closing the pipe by other means as decided by the Bidder, and then preserve the pipeline until GPA completes construction of the LNG supply facilities, at which time the gas pipeline will be connected to the gas line coming from the LNG regasification system constructed by others.

QUESTION:

19. Purchase Guarantee
    For any bidder to produce a rough financial model for tariff purposes, the Bidder will need to understand the potential revenue stream which will rely heavily on the amount the plant is dispatched and for how many MWh per year or per month. Even if the Bidder has no issues matching the required 90% availability, if GPA is not dispatching the plant (thus not allowing it to output energy to the grid) then this will directly affect the Bidder's revenue stream. Moreover, GPA has required 360 start/stop in one year which raises additional concerns of dispatching. For all bidders to be on similar playing field, can GPA provide the projected yearly MWh dispatching schedule? And if GPA is unable to dispatch the new plant then will there be a reimbursement plan so that the Bidder can have a minimum revenue stream?

ANSWER:

Please read the tariff structure description (Section B, Article 4 of the IFMSB). The tariff structure includes two components – Capacity Charge and Energy Charge. Capacity Charge consists of Fixed Capacity Charge designed to allow the Project Company to recover their equity investment and service debt, and Fixed Operation and Maintenance Charge to cover fixed O&M costs. The Capacity Charge is paid regardless of whether the plant is dispatched or not and is only dependent on the plant Dependable Capacity. In other words, the Capacity Charge provides a steady revenue stream to the Project Company regardless of the plant dispatch.

QUESTION:

20. GPA Production Capability
As we understand the baseload demand on Guam is roughly 250 MW plus or minus. With NRG solar plant (25MW), Phase II renewables (120MW) and MEC 8&9 (88MW) the baseload production is already at 233 MW and if Phase III renewable is included then there will be a total production of 273 MW. Our concern is that this new 180 MW power plant will run more like a semi-peak plant rather than a baseload plant considering the available production capability at the time of COD. We understand that extra production capability is needed for redundancy but we would like to obtain a hierarchy list to understand which plants on Guam will have precedence over the other when running baseload including Phase I, Phase II, Phase III, MEC 8&9 and the new 180 MW power plant.

ANSWER:

GPA anticipates that the new power plant will be the most efficient fossil fuel power plant in the GPA system and will have the lowest marginal cost. As a result, it is expected that the new power plant will be dispatched before the existing GPA fossil fuel power plants except that some of the existing power plants may be dispatched at minimal loads to provide certain rotating reserve in the system. Renewable energy will be taken by the system whenever it is available, so with increase in PV solar capacity in Guam the new plant would have to operate at reduced loads during the hours of the day when solar power generation is at its' peak.

<u>Qualified Bidder #1 dated 11/28/2018:</u>

QUESTION:

1. Evaluation Model
Overnight Capital Cost for System Reserve in the Evaluation Model (Excel sheet)

In case new power plant is equipped with back-up facility such as battery system, additional turbine or engine to cover the single unit trip loss, bidder can consider not to apply Overnight Capital Cost for System Reserve in the Evaluation Model. Please confirm our understanding.

ANSWER:

System reserve provides firm capacity that is available to be dispatched at any time, 24 hours a day and generate the required capacity during forced and scheduled outages of generating units at power plants connected to the GPA system. Unless the Bidder can demonstrate that a battery system can provide firm dispatchable generating capacity similar to what can be provided by fossil fueled units used by GPA as reserve margin, the Overnight Capital Cost for System Reserve will be applied.

QUESTION:

2. Discount Rate
   IFMSB Section D, 15.7.1 Assumptions for Evaluation
   - 2. Discount Rate: For purposes of evaluation, the discount rate used to calculate the Present Value (PV) will be 7% on an annual basis

   Discount Rate in the Evaluation Model: 10%

   The discount rate (10%) of the Evaluation Model is different from the discount rate (7%) for calculation of PV of IFMSB. Which one is correct?

ANSWER:

10% discount rate used in the model is correct.

QUESTION:

3. Start-up duration and Start-up Cost in the Evaluation Model
   ○ IFMSB Section A, 2.1 Definitions
   - 89. Startup - The process of starting up a Unit or the Facility until its synchronization with the Grid System

   ○ IFMSB Section C, 2.2.3 Start Up Duration
   A. The start-up duration is defined as the time for each unit to reach its full net capacity from initiation of start-up sequence. The Project Company shall provide a startup duration, including from hot and cold conditions. Project Company's offering combined cycle plants shall provide startup times for the simple cycle unit as well as for individual steam generators associated with each combustion Turbine Generators

   There is a discrepancy in the definition of start-up. Please clarify whether Start-up Cost in the Evaluation Model has to be considered until its synchronization or full net capacity.

ANSWER:

For the purposes of Evaluation Model, the fuel component of startup cost should be the cost of fuel required to bring the unit to synchronization as fuel cost of unit operation after it starts to generate electricity will be compensated based on the Fuel Charge provisions of the tariff. The non-fuel component of the startup cost is not expected to depend on how the startup is defined.
For technical and operating purposes GPA needs to understand the startup duration from initiation of startup sequence to reaching unit's full net capacity. The Bidders must provide the startup curves for cold, hot, and warm starts as part of the technical section of their Proposal.

QUESTION:

4. Evaluation Model
   Annual Availability in the Evaluation Model (Excel sheet)

   1. Generally plant availability is defined as calculation based on outage time.

      Availability= $$\frac{8{,}760(Hr) - Planned\ Outage(Hr) - Forced\ Outage(Hr)}{8{,}760(Hr)}$$

   2. However, according to the Evaluation Model, the availability is used in order to calculate plant output in MW and it results plant operation in part loads lowering plant efficiency unlike the general understanding of "Availability" and actual plant operation concept. Availability factor shall be applied for calculation of FCC and FOMC.
      Please re-consider our understanding.

ANSWER:

The Availability as defined in Section A of the IFMSB includes both outages and deratings. Please note that the availability guarantee and plant heat rates are requested for the entire plant, so depending on plant's configuration and number of units it may be possible that the plant's heat rate at partial load (calculated by multiplying Contracted Capacity by availability guarantee) is equal or very close to the heat rate of the plant operating at full load. Given that (i) GPA will be impacted by plant generation cost across the entire load range associated with expected dispatch profile, (ii) there is potential for increased partial load operation in the future depending on intermittent renewable penetration, and (iii) the ECA will have a base term of 25 years, the Evaluation Model considers the availability guarantee by reducing capacity of the plant evenly through the year.

QUESTION:

5. Site Size
   - MS GPA-034-18 Step 2 Section A 5.3 Site
   Section C 5.3 Site Size and Layout
   - Section A : Bidders may utilize up to 25 acres of the GPA property for the Facility Site, but may be allowed to use additional area within the GPA property during the construction period.
   - Section C : Property consists of 60 plus acres near Harmon substation in Dededo. The estimated plant footprint is 25 acres. Project Company shall not build in the area outside the plant footprint other than for utility access.

   Bidder understands that 35 acres (remaining area other than plant footprint 25 acres) of the GPA property will be allowed to use free of charge for laydown area during construction period. Please clarify it.

ANSWER:

Project Company may use up to 35 acres temporarily provided that they make every effort to minimize the clearing of the existing vegetation.

QUESTION:

6. Country of Origin

   Please inform any limitation of country of origin for material and equipment.

ANSWER:

The limitations on the country of origin and specific firms and individuals are specified in the U.S. Department of Treasury Office of Foreign Assets Control (OFAC) Sanctions Programs and Country Information https://www.treasury.gov/resource-center/sanctions/Programs/Pages/Programs.aspx

QUESTION:

7. Simple Cycle Operation
   - MS GPA-034-18 Step 2 Section A 1.1.5 Schedule
   Although the IFMSB will include Phases, GPA will have the option to obligate the Selected Bidder to eliminate the concept of Project phases and to commission the entire Facility at once. In that case, the Phase 1 Commercial Operation Date shall be disregarded and the Phase 2 Commercial Operation Date shall become the commercial operation date for the entire completed Facility.

   Please confirm,
   1. If a part (not all unit) of the Simple Cycle Unit as Contracted Facility Capacity can be operated in case of combined cycle facility during Phase 1.

   2. If yes, please clarify what will be the required minimum output (MW) during Phase 1.

ANSWER:

1. Yes.

2. 100 to 108 MW minimum output limit for Phase1 which is about 90% of the Simple Cycle as contracted facility capacity output.

QUESTION:

8. ULSD Storage
   - MS GPA-034-18 Step 2 Section A, 9.1.1 ULSD Storage

   During the term of the ECA GPA will be allowed to access Bidder's on Site ULSD storage facilities to fuel GPA's tanker trucks at no charge.

   Please clarify;
   - Dimension of tanker trucks
   - How many trucks will be parked in a time?
   - Necessity of dedicated pumps for the tanker trucks

   Please provide us of detailed specification for the fuel transfer facility for loading trucks.
   - required unloading capacity of station (how many tracks and unloading period for each truck)

ANSWER:

a. GPA contracts third party tanker trucks with similar dimensions as shown in drawing – Q10-Tank Trailer Dimensions (8500 US Gallons).pdf for delivery. Tankers can deliver 8500 US gallons of ULSD.
   GPA cannot determine how many tankers will be parked in a time. However, GPA has contracts with local fuel suppliers that have fuel transfer facilities for loading trucks of similar design as shown in the drawing - Q11- Truck Loading Gantry.pdf which can accommodate two (2) tanker trucks at a time.
   It will be necessary to dedicate pumps for the tanker trucks similar to fuel transfer facility shown in the drawing- Q11- Truck Loading Gantry.pdf

b. The Project Company is responsible to design the fuel transfer facility. GPA has provided a drawing of the fuel transfer facility for trucks for reference – see the response to the first part of the question above.

QUESTION:

9. Gas Handling Facilities
   - MS GPA-034-18 Step 2 Section A, 9.2 Natural Gas

   Gas handling facilities, including filtering, metering, pressure reducing equipment and heaters, will be constructed and operated by the Project Company within the Site boundary.

   Bidder understands the 'heaters' mean dewpoint heater in this context. If they do, please clarify;
   - Maximum hydrocarbon dewpoint of the natural gas
   - Temperature range of the natural gas

ANSWER:

The natural gas properties are not known at this point. For the purposes of their Proposal, the Bidders can assume -5^{o}C as water dew point at 60 bar(g) and hydrocarbons dew point of 0^{o}Cat any pressure.

QUESTION:

10. Natural Gas Properties
    - MS GPA-034-18 Step 2 Section A, 9.2 Natural Gas

    Gas pressure at the interface point is expected to be approximately 60 bars. Natural Gas properties are provided in IFMSB Section C, Functional Technical Specification.

    Please clarify the unit 'bars' means 'barg' or 'bara'.

ANSWER:

Bar(g).

QUESTION:

11. ULSD Fuel Charge
    - MS GPA-034-18 Step 2 Section B, 4.4.2.1 ULSD Fuel Charge

    For evaluation purposes, an “all-in” unit cost of ULSD will be used as stated in Section D, Envelope II “Present Value”.

    Please clarify the 'all-in unit cost'.

ANSWER:

“All-in” means the cost as delivered to the site (the cost including both commodity price and transportation cost).

QUESTION:

12. Natural Gas Fuel Charge
    - MS GPA-034-18 Step 2 Section B, 4.4.2.2 Natural Gas Fuel Charge (when it becomes available)

    For evaluation purposes, an “all-in” unit cost of fuel will be used as stated in Section D, Envelope II “Present Value”.

    Please clarify the 'all-in unit cost'.

ANSWER:

“All-in” means the cost as delivered to the site (the cost including both commodity price and transportation/regasification cost).

QUESTION:

13. Water Storage Tank
    - MS GPA-034-18 Step 2 Section C, 1.2.5 Detailed Project Scope

    Water storage tanks (e.g. raw water, dedicated fire water, service water, potable water, etc.) as required. There shall be 7 days of water storage for cycle makeup and cooling tower makeup if cooling tower is required.

    Please clarify whether the service water and potable water also need 7 days of storage.

ANSWER:

Service water and potable water do not require 7 days storage. Only the grey water requires on site storage due to the intermittency of GWA's treatment and discharge.

QUESTION:

14. Availability and Reliability
    - MS GPA-034-18 Step 2 Section C, 2.2.6 Availability and Reliability

    It is expected that the Facility will operate based on economic dispatch, with an average annual Equivalent Availability Factor during the plant lifetime of no less than 90%. The Equivalent Availability Factor Formula is defined in accordance with ANSI/IEEE Standard 762-1987, Appendix C, Equation C-7 as follows:

    Is the plant part load operation by the grid operator included in the EAF calculation?

ANSWER:

No. EAF does not consider the actual load, but rather the capacity that can be generated based on equipment conditions.

QUESTION:

15. Noise
    - MS GPA-034-18 Step 2 Section C 2.2.8 Noise

    A. Noise level at the site boundary shall not exceed 45 dB(A), measured in the horizontal plane and at an elevation of 5 feet (1.5 meters) from grade with all equipment running at full capacity.

    The noise limit of 45 dBA at site boundary is extremely severe and uncommon requirement. Please reconsider.

ANSWER:

GPA is commissioning a background noise survey that will be provided to bidders by the end of January. The noise requirement will be adjusted to the World Bank Group International Finance Corporation EHS Guidelines - 1.7 Noise.pdf – see attached. Bidders must apply appropriate noise control methods to assure compliance.

QUESTION:

16. Tests on Completion (Partial Commissioning)
    - MS GPA-034-18 Step 2 Section C, 4.2.5 Tests on Completion

    J. Partial Commissioning

    1. Project Company shall perform tests to demonstrate that generating units can be partially commissioned and operated without negatively impacting site safety and the ongoing construction efforts.

    Please clarify the Partial Commissioning.

ANSWER:

Partially commissioned refers to commissioning in phases and means that units constituting Phase 1, when commissioned must satisfy the above requirements.

QUESTION:

17. Site Reference Conditions
    - MS GPA-034-18 Step 2 Section C 5.5 Site Reference Conditions

    1. The following are the site reference conditions, to be used for the basis of the plant guarantees:
        a. Ambient Dry Bulb Temperature (°F): 88.9
        b. Barometric Pressure (psia): 14.57
        c. Wet Bulb Temperature (°F): 78.1

    The average barometric pressure is around 14.65 psia in Dededo area over 10 years. (reference: https://www.worldweatheronline.com/dededo-weather-averages/guam/us.aspx)

    We would like to request GPA to adjust the ambient pressure to a higher level accordingly

ANSWER:

Agreed.

QUESTION:

18. Storm Event
    - MS GPA-034-18 Step 2 Section C, Appendix B 3.5 ULSD Plant Terminal Design and Construction Considerations

    The site shall include spill containment in accordance for 40 CFR 112 and NFPA 30, and at a minimum shall provide 100% containment plus a 25-year/24-hour storm event for the single largest vessel.

    The 24 hour storm event is too conservative for dyke design. Please consider to loosen the requirement.

ANSWER:

Project Company may propose a less stringent requirement, providing Project Company will take measures during storm event to drain the dike area.

QUESTION:

19. ULSD Analysis
    - MS GPA-034-18 Step 2 Section C, Appendix F: ULSD Analysis

    Appendix F: ULSD Analysis

    In order to check the operability of the ULSD, please inform us of following additional data
    - Sodium+Potassium
    - Lead
    - Vanadium
    - Calcium
    - Other trace metals
    - Water and Sediment
    - Pour point

ANSWER:

GPA doesn't analyze the additional data for ULSD therefore couldn't provide them.

QUESTION:

20. Air emissions – Nox
    - MS GPA-034-18 Step 2 Section C, 8.10.1 Air Emissions

    Air emissions – Nox

    Please confirm Bidder shall comply NOx emission limit during simple cycle operation (first year or during commercial operation period)

ANSWER:

The NOx requirements for the first year of operation as well as for the rest of the plant operating period will be defined by the air permit obtained by the Bidder. GPA will have no issue with Phase 1 operating with higher NOx emission during the first year of commercial operation in case it will be allowed by the air permit issued by the U.S. EPA and Guam EPA.

QUESTION:

21. Assumptions for Evaluation - Supplemental Charges
    - MS GPA-034-18 Step 2 Section C, 15.7.1 Assumptions for Evaluation

    8 Supplemental Charges: For purposes of evaluation, it will be assumed that there will be 360 starts per Unit per Contract Year in addition to the annual startup allowance specified in Section B, Article 4.5.

    Considering the Facility will be a primary power source for Guam, and will be operated at full load at least 90% EAF, assuming 360 starts per Unit in addition to the annual startup allowance specified in Section B, Article 4.5 is unrealistic. A practical number of startup should be given for a fair evaluation and to reflect reality.

ANSWER:

Response shall be forthcoming.

QUESTION:

22. ULSD Storage Capacity
    - MS GPA-034-18 Step 2 Section A, 9.1.1 ULSD Storage

    The Bidder shall provide additional on-Site ULSD storage with storage capacity sufficient to support thirty (30) days of Facility operation at full load.

    - MS GPA-034-18 Step 2 ENERGY CONVERSION AGREEMENT,

    4.3.1 Fuel Supply After COD
    (g) Project Company shall, in accordance with Schedule 1, construct and maintain storage facilities at the Site for the supply of ULSD for the operation of the Facility (the "ULSD Storage Facilities"). Such storage facilities shall be capable of holding an inventory equivalent to the amount of ULSD necessary to operate the Facility at the full Contracted Facility Capacity (in accordance with the Guaranteed Heat Rate) for at least fourteen (14) consecutive Days or such larger quantities as may be required by Lenders.

    There are discrepancies on the ULSD storage capacity basis. Please clarify;
    - 14 days or 30 days?
    - Capacity factor is considered or not?

ANSWER:

30 days is correct. Full load means that no capacity factor is considered.

QUESTION:

23. Emission guarantee (air, water)
    - MS GPA-034-18 Step 2 Section A, 11 Environmental requirements

    The Bidder shall meet all the applicable environmental requirements of the Guam EPA and U.S. EPA and obtain environmental permits required for construction and operation of the Facility. Guam EPA permitting and compliance requirements can be found at the http://epa.guam.gov website. U.S. EPA requirements are specified in the CFR Title 40, Protection of Environment which is available from the website https://www.ecfr.gov/cgi-bin/textidx?gp=&SID=3fd3e483e9690934bccc0bcc570a96f3&mc=true&tpl=/ecfrbrowse/Title40/40tab_02. tpl.

    Even though above requirement states that all the applicable information has to refer specific website, air emission limit for power plant is not defined in "Chap 1. Guam Air Pollution Control Standards and Regulations, Division 1., Title 22" which is linked with the website. For this reason, please provide required environmental requirement (air emission limit etc.) for this project.

ANSWER:

GPA cannot establish the emission limits. The emission requirements will be determined by the EPA in the air permit to be obtained by the Project Company based on whether the plant will be considered a minor or major source and how the Best Available Control Technology (BACT) requirement is applied to the project. It is recommended for the Bidder to contact U.S. EPA to understand the approach they are going to take when considering the air permit for such a project in Guam.

QUESTION:

24. SCR application
    - MS GPA-034-18 Step 2 Section A, 11 Environmental requirements

    In case selective catalytic reduction (SCR) shall be applied to comply emission requirement, please provide ammonia slip (NH3) limit.

ANSWER:

GPA cannot establish the ammonia slip limit. This will be determined by the EPA in the air permit to be obtained by the Project Company.

QUESTION:

25. Site Level
    - MS GPA-034-18 Step 2 Section A 5.3 Site

    The Site is located approximately 80 meters above the mean sea level.

    Topographic survey map shall be required for the assessment of site preparation work.
    Please provide the topographic survey map (Autocad file).

ANSWER:

Response shall be forthcoming.

QUESTION:

26. OBL
    - MS GPA-034-18 Step 2 Section C, 3.3.2 General Design Requirement

    A. Water supply: The plant potable water supply will originate from the GWA public water supply. Cooling water will be drawn from the effluent of the GWA Northern District Wastewater Treatment Plant. Project Company shall treat the water as necessary for service water, fire water, and boiler makeup.

    Topographic survey map shall be required for the assessment of civil work for portable water line and cooling water line.
    Please provide the topographic survey map (Autocad file) including existing structures and geotechnical investigation report for portable water line and cooling water line.

ANSWER:

Response shall be forthcoming.

QUESTION:

27. Design factor
    - MS GPA-034-18 Step 2 Section C, 3.4.7 Foundation Design

    C. Stability - Minimum factor of safety:
    1. Overturning: 1.5
    2. Stability against sliding: 1.5
    3. Uplift 1.0 (75% of Dead load used as resisting)
    4. Lateral forces shall be resisted in accordance with the geotechnical report

    It is unusual that 75% of Dead load is used as resisting for uplift check. Bidder propose that 100% of Dead load be used as resisting and Minimum factor of safety be 1.1.
    Please confirm it.

ANSWER:

100 percent of the dead load shall be used for checking resistance to uplift. Reduced dead load is accounted for in the applicable load combinations in Chapter 16 of IBC 2009.

QUESTION:

28. Geotechnical survey
    - MS GPA-034-18 Step 2 Section C, 5.6 Geotechnical Conditions

    GPA will complete a preliminary geotechnical survey to be provided during this procurement period.

    Please provide the preliminary geotechnical survey report including Soil investigation data.

ANSWER:

GPA will provide the preliminary geotechnical report after it is completed. However, GPA is providing the test boring location plan, test boring logs and soil classification system in 127.05 - Appendix A.pdf.

QUESTION:

29. New pipeline
    - MS GPA-034-18 Step 2 Appendix B, 3.4 Pipeline Routing and Construction Consideration

    New pipeline routing shall follow existing pipeline corridors and access roads where possible. Existing roads shall not be used for construction and maintenance of new pipelines.

    Please provide related drawing for new pipeline (including Autocad file).
    1. Topographic survey map
    2. Existing pipeline corridor drawings
    3. Underground obstacle drawings such as utilities line, service waterline, sewer line, stormwater line, electrical cable line, etc. along ULSD new pipelines routes.

ANSWER:

Response shall be forthcoming.

QUESTION:

30. Building Requirement
    - MS GPA-034-18 Step 2 Section C, 3.7.2 Building Requirements

    c. A guard house shall be provided at each entrance to the facility.

    1. Bidder understands that mentioned "entrance to the facility" is the access to the plant from outside of plant boundary. Please clarify it.

ANSWER:

Confirmed – each access to the plant from outside the plant boundary shall have a security guard house.

QUESTION:

31. Seismic Load
    - MS GPA-034-18 Step 2 Section C, 3.4.5 Structural Loads

    6. Earthquake Loads – E

    Per IBC 2009 Section 1613 and PPRBC Section RBC302.4.35
    Occupancy Category: IV
    Importance factor, I: 1.5
    Short Period Spectral Response Parameter Ss = 2.86
    1 Second Spectral Response Parameter S1 = 0.61

    Bidder found that given Ss and S1 value in IFB requirement is different from the value shown in referenced code. (IBC 2009 - based on ASCE 7-05)
    The value of Ss and S1 for Guam shown in IBC 2009 (and ASCE-7-05) are 1.5 and 0.6, respectively. Please clarify it.

ANSWER:

Short period spectral response acceleration Ss shall be equal to 1.50. 1 second spectral response acceleration S1 shall be equal to 0.60.

QUESTION:

32. Structural Load
    - MS GPA-034-18 Step 2 Section C, 3.4.5 Structural Loads

    5. Wind Loads - W
    Per IBC 2009 Section 1609
    Occupancy Category: IV
    6. Earthquake Loads – E
    Per IBC 2009 Section 1613 and PPRBC Section RBC302.4.35
    Occupancy Category: IV

    Occupancy Category of buildings and other structures given in IFB requirement is defined as IV. Bidder would like to suggest Occupancy Category of structures that will be applied for the project as III (as shown in IBC 2009 & ASCE 7-05), the conventional application for power plant.

ANSWER:

Occupancy Category IV shall be used for design of all buildings, structures, and ancillary facilities required for operation of Category IV structures in an emergency (e.g. typhoon, earthquake). Facilities not classified as Occupancy Category IV may be designed using the applicable Occupancy Category contained in Table 1604.5 of IBC 2009 but not less than Occupancy Category II.

QUESTION:

33. Natural Gas
    - MS GPA-034-18 Step 2 Section C, APPENDIX B - ULSD AND OR NATURAL GAS STORAGE AND PIPE LINE STRUCTURE

    As per MS GPA-034-18 Step 2 - Amd I Final_Bidder #1 question no.1, Bidder understand that LNG pipeline shall be included in Bidder's scope of supply from LNG Bulk storage tank to Plant site. Please clarify our understanding is right.
    Below are additional question about LNG pipeline.

    * Terminal Point Information
    1)Connecting Piping size
    2)Terminal Point connection type (Flange or Valve or welding)
    3)Above or Underground
    4)Coordination
    5)Process condition

ANSWER:

1. Piping size is currently unknown
2. Terminal point will be near GPA Bulk Fuel Storage Facility near Apra
3. Connection will be above ground
4. Currently unknown
5. Vaporized LNG

QUESTION:

34. Natural Gas
    - MS GPA-034-18 Step 2 Section A, 9.2 Natural gas

    Gas pressure at the interface point is expected to be approximately 60 bars.

    Please provide exact location of the interface point where gas pressure is 60 bars.

ANSWER:

Terminal point near GPA Bulk Fuel Storage Facility near Apra.

QUESTION:

35. J. Step-up and Auxiliary Transformers
    - MS GPA-034-18 Step 2 Section C, 3.2.2 General Design Requirements

    8. Provide tap voltages of +/- 2.5% and +/- 5% on the primary winding. Each tap position shall be fully rated and shall not limit kVA rating of transformer.

    The type of tap changer are not mentioned in this IFB. So, No load tap changer will be considered and voltage tap position will be followed IFB i.e +/- 2.5% and +/- 5% on the primary winding.
    Please clarify it.

ANSWER:

Response shall be forthcoming.

QUESTION:

36. P. General Plant Requirements
    - MS GPA-034-18 Step 2 Section C, 3.2.2 General Design Requirements

    1. Medium Voltage Power Cable

    ...d. PVC jacketing not allowed.

    Please confirm if HDPE (high density polyethylene) jackets are allowed

ANSWER:

HDPE jacketing is allowed.

QUESTION:

37. CEMS
    - MS GPA-034-18 Step 2 Section D, 8.10.1 Air Emissions

    Table 8.2 Natural Gas Emission Levels

    Provide total emissions for all air toxics on an aggregate basis, not on an individual basis. Air toxic pollutants are described on the US EPA Web page:

    Bidder clarifies that Continuous Emission Monitoring System (CEMS) for the detection of NOX, CO, SO2, Particles, shall be provided, referring to the US EPA.

ANSWER:

Response shall be forthcoming.

<u>Qualified Bidder #5 dated 10/19/2018:</u>

QUESTION:

47. Section C, 3.5.1, B., Page Number 141
    Guam Power Authority Standard Specifications as applicable (for Substation)

    Please provide applicable Guam Power Authority Standard Specifications

ANSWER:

These are the available Guam Power Authority Standard Specifications for Substation:

- 11Q - Potential Transformer.pdf
- Dededo Indoor Sub FINAL Specs Complete Set 06-24-13.pdf
- Spec E-039 - 115 kV AC Power Gas Circuit Breakers Outdoor Type.pdf
- Spec E-041 Revision 1 - Station Battery Bank.pdf
- Spec E-042 Revision 2 - Station Battery Charger.pdf
- Spec E-049 Revision 0 - 115 KV 34.5 KV Substation Power Transformer Outdoor Type.pdf
- Spec E-050 Revision 0 - 115 KV 13.8 KV Generation Power Transformer Outdoor Type.pdf
- Spec E-051 Revision 0 - Three Pole Group Operated Air Disconnect Switch.pdf

QUESTION:

70. ECA draft Article 9, Page Number 558
    Project Company shall pay to GPA, as liquidated damages, an amount equal to US$ [TBD] per kW of the shortfall between the most recently determined Initial Dependable Capacity and the Contracted Phase 1 Capacity.

    Project Company shall pay to GPA, as liquidated damages, an amount equal to US$ [TBD] per kW of the shortfall between the most recently determined Initial Dependable Capacity and the Contracted Phase 2 Capacity.

    Why are the LD levels highlighted in yellow? Does the Bidder need to propose?

ANSWER:

Kindly see revised draft ECA for the amounts for liquidated damages (attached).

<u>Qualified Bidder #5 dated 11/30/2018:</u>

QUESTION:

1. Sample Evaluation Model

   The Sample Bid Evaluation Model 'Assumption' sheet includes various GPA Inputs including Fuel Prices, Existing Diesel Generators, Spinning Reserves etc. Should we assume that these assumptions are final and assume the same in our bid?

ANSWER:

Yes.

QUESTION:

2. Sample Evaluation Model

   Please unprotect the sheets in Sample Bid Evaluation Model (File: Sample Bid Evaluation Model Final Protected MS GPA-034-18 Step 2 Amd V)

ANSWER:

   Bid Evaluation Model calculation spreadsheets are intentionally protected to avoid the possibility of Bidders making changes to formulas and assumptions and will therefore remain protected.

QUESTION:

3. FOMC and VOMC calculation
   Section B, 4.3.2/Section B, 4.4.1; Page Numbers 66~68

   According to MS GPA-034-18 Step 2 (RFP) p66~68, the FOMC and VOMC should be indexed. However, we cannot find any indexation in the Sample Bid Evaluation Model. Please confirm that index will not be considered in bid evaluation.

ANSWER:

   For evaluation purposes FOMC and VOMC are not indexed. However, invexation will be applied to FOMC and VOMC payments pursuant to the ECA.

QUESTION:

4. Amendment VI, Question 40

   In the response to this question, GPA indicates “Draft ECA will be amended accordingly.” Please confirm whether this amended draft ECA, or any other drafts, schedules or addendums to the Project Documents are expected by GPA to be circulated for Bidders to review, ahead of the bid submission deadline.

ANSWER:

   Kindly see revised draft ECA (attached).

QUESTION:

5. GPA Section 1 (Definitions)

   “Changes in Law” and “Cause”: In Section 1 of the ECA, both the “Change of Law” and the “Cause” definitions seem to indicate that the only applicable law is the “Laws of Guam” – however, it appears that Change of Law should capture both the Laws of Guam and any applicable Laws of the United States. Please confirm whether the applicable law includes both Laws of Guam and the United States for the purposes of “Change of Law” and “Cause” definitions.

ANSWER:

The references to applicable law included in the definitions of “Change of Law” and “Cause” should capture applicable laws of the Guam and US laws related to environmental and will be clarified in the ECA.

QUESTION:

6. GPA Section 14.2 (Payment), Amendment VI, Question 59

The second paragraph states “GPA intends to make an initial lump sum payment of approximately $50 million upon COD to reduce interest fees and payments over the contract term.” GPA also clarified such amounts will be wired to the Project Company in cash or cash equivalent. May we understand that the intention is the first $50 million of any payments due under the ECA from GPA to the Project Company will be offset against such amount prepaid to the Project Company, after which GPA will make payments under the ECA as otherwise stipulated?

ANSWER:

The intent of the $50 million payment is to lower the tariff charged by the Project Company over the ECA term as GPA is interested in reducing the rate charged to ratepayers. The Bidder must use the $50 million proceeds in such a manner that the level of tariff is reduced over the entire duration of the ECA (for example, refinancing the debt by applying $50 million towards principal, which would lower debt service payment and result in the lower FCC charge over the ECA term). $50M paid upon completion of work done and approved by GPA, for example pipeline, infrastructure etc.

<u>Qualified Bidder #6 dated 10/29/2018:</u>

QUESTION:

25. Draft ECA / 5.1 (a) Term of Agreement

There's an Error Reference source not found? Can you provide the missing information related to this Section?

ANSWER:

The reference is to Article 6.6. (Addressed in Amendment No.: VII dated November 30, 2018)

UPDATE:

Kindly see revised draft ECA for missing information related to Article 6.6. (attached).

QUESTION:

28. Draft ECA / 8.5 Deemed Commissioning

There's an Error Reference source not found? Can you provide the missing information related to this Section?

ANSWER:

The reference is to Article 6.6.c. (Addressed in Amendment No.: VII dated November 30, 2018)

UPDATE:

Kindly see revised draft ECA for missing information related to Article 6.6.c. (attached).

Qualified Bidder #4 dated 11/01/2018:

3. [A] 7.4; Labor Information

Labor for construction and operation of the Facility may not be available locally. Select existing GPA plants are to be retired within one (1) year following the new power plant commissioning. The Project Company shall give existing GPA power facilities maintenance and operations employees who will be adversely affected or separated as a result of commissioning of the new power plant the right of first refusal for employment at the new power plant in positions for which they are qualified. For each case of hiring an existing GPA maintenance and/or operating employee the Project Company shall advise GPA about their plan for hiring such employee and allow a minimum of 6 months before beginning the employment period to allow GPA to adjust its' plant operation and maintenance activities. GPA may require assistance from the Project Company in finding a temporary labor pool for positions at their existing power plants that will be vacated

Please provide organization charts and number of employees at the existing GPA plants to be retired.

ANSWER:

Please see attached Generation Cabras1&2 Org Chart.pdf for organization charts and number of employees at the existing GPA plants to be retired.

All other Terms and Conditions in the bid package shall remain unchanged and in full force.

JOHN M. BENAVENTE, P.E.
General Manager

1.7 Noise

Applicability

This section addresses impacts of noise beyond the property boundary of the facilities. Worker exposure to noise is covered in Section 2.0 on Occupational Health and Safety.

Prevention and Control

Noise prevention and mitigation measures should be applied where predicted or measured noise impacts from a project facility or operations exceed the applicable noise level guideline at the most sensitive point of reception.[52] The preferred method for controlling noise from stationary sources is to implement noise control measures at source.[53] Methods for prevention and control of sources of noise emissions depend on the source and proximity of receptors. Noise reduction options that should be considered include:

- Selecting equipment with lower sound power levels
- Installing silencers for fans
- Installing suitable mufflers on engine exhausts and compressor components
- Installing acoustic enclosures for equipment casing radiating noise
- Improving the acoustic performance of constructed buildings, apply sound insulation
- Installing acoustic barriers without gaps and with a continuous minimum surface density of 10 kg/m^2 in order to minimize the transmission of sound through the barrier. Barriers should be located as close to the source or to the receptor location to be effective
- Installing vibration isolation for mechanical equipment
- Limiting the hours of operation for specific pieces of equipment or operations, especially mobile sources operating through community areas
- Re-locating noise sources to less sensitive areas to take advantage of distance and shielding
- Siting permanent facilities away from community areas if possible
- Taking advantage of the natural topography as a noise buffer during facility design
- Reducing project traffic routing through community areas wherever possible
- Planning flight routes, timing and altitude for aircraft (airplane and helicopter) flying over community areas
- Developing a mechanism to record and respond to complaints

Noise Level Guidelines

Noise impacts should not exceed the levels presented in Table 1.7.1, or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

[52] A point of reception or receptor may be defined as any point on the premises occupied by persons where extraneous noise and/or vibration are received. Examples of receptor locations may include: permanent or seasonal residences; hotels / motels; schools and daycares; hospitals and nursing homes; places of worship; and parks and campgrounds.

[53] At the design stage of a project, equipment manufacturers should provide design or construction specifications in the form of *"Insertion Loss Performance"* for silencers and mufflers, and "*Transmission Loss Performance"* for acoustic enclosures and upgraded building construction.

Table 1.7.1- Noise Level Guidelines[54]		
	One Hour L_{Aeq} (dBA)	
Receptor	Daytime 07:00 - 22:00	Nighttime 22:00 - 07:00
Residential; institutional; educational[55]	55	45
Industrial; commercial	70	70

Highly intrusive noises, such as noise from aircraft flyovers and passing trains, should not be included when establishing background noise levels.

Monitoring

Noise monitoring[56] may be carried out for the purposes of establishing the existing ambient noise levels in the area of the proposed or existing facility, or for verifying operational phase noise levels.

Noise monitoring programs should be designed and conducted by trained specialists. Typical monitoring periods should be sufficient for statistical analysis and may last 48 hours with the use of noise monitors that should be capable of logging data continuously over this time period, or hourly, or more frequently, as appropriate (or else cover differing time periods within several days, including weekday and weekend workdays). The type of acoustic indices recorded depends on the type of noise being monitored, as established by a noise expert. Monitors should be located approximately 1.5 m above the ground and no closer than 3 m to any reflecting surface (e.g., wall). In general, the noise level limit is represented by the background or ambient noise levels that would be present in the absence of the facility or noise source(s) under investigation.

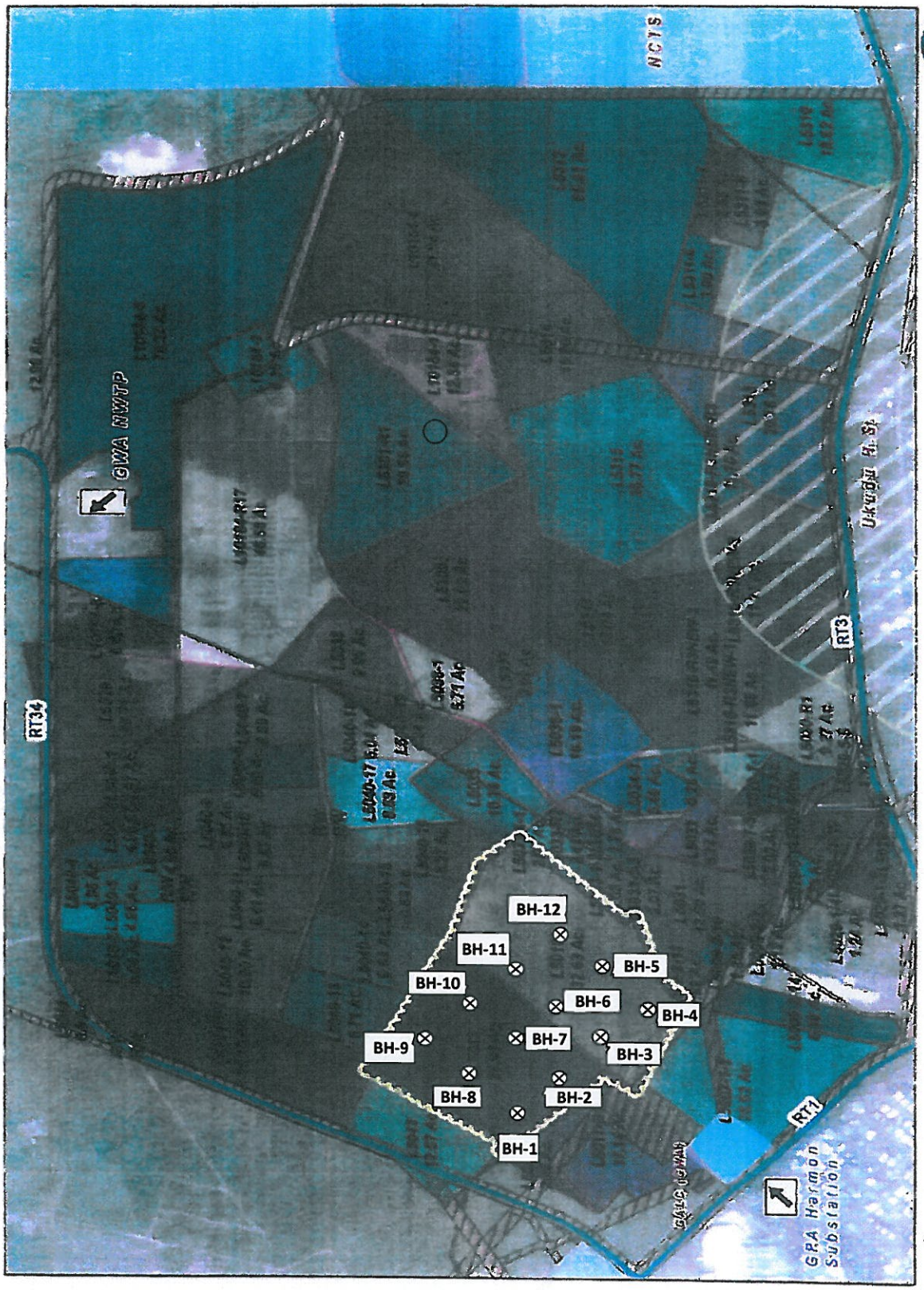
[54] Guidelines values are for noise levels measured out of doors. Source: Guidelines for Community Noise, World Health Organization (WHO), 1999.

[55] For acceptable indoor noise levels for residential, institutional, and educational settings refer to WHO (1999).

[56] Noise monitoring should be carried out using a Type 1 or 2 sound level meter meeting all appropriate IEC standards.

APPENDIX A

Test Boring Location Plan, Test Boring Logs, and Soil Classification System



GEO-ENGINEERING & TESTING, INC. Geotechnical & Material Testing Engineers	**TEST BORING LOCATION PLAN** GPA NEW POWER PLANT	**PLATE** **1**
Job No. 127.05 **Appr.** US/ **Date** 12/31/18	DEDEDO GUAM	

Notes:

Relatively undisturbed sample

SPT/Bulk Sample

SPT = Standard Penetration Test based on 63.5 kg (140 lb) hammer free falling 76 cm (30 in.)/blow

LOG OF TEST BORING 1

DATE December 08, 2018

EQUIPMENT 8" Dia. Hollow Stem Auger

ELEVATION --

DEPTH (FT.)	DEPTH (M)	DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE	DRILL RATE (time/foot)	SPT, N-Value (Blows/ft)	MOISTURE CONTENT, %	DRY DENSITY, lb/cu.ft	LABORATORY TESTS
0	0	REDDISH BROWN GRAVELLY SANDY SILT (MH) - medium stiff, moist							
	0.6	LIGHT BROWN-WHITE CORALLINE LIMESTONE - weak				33			
3	1.2								
6	1.8								
	2.4					42			
9		moderately hard from 9'							
	3								
12	3.6					55			
	4.2								
15	4.8								
	5.4					53			
18									
	6	hard from 20'							
21									

GEO-ENGINEERING & TESTING, INC.
Geotechnical & Material Testing Engineers

Job No. 127.05 Date 12/10/18

LOG OF TEST BORING 1

GPA NEW POWER PLANT

DEDEDO, GUAM

PLATE 2

Notes:

Relatively undisturbed sample

SPT/Bulk Sample

SPT = Standard Penetration Test based on 63.5 kg (140 lb) hammer free falling 76 cm (30 in.)/blow

LOG OF TEST BORING 1

DATE December 08, 2018

EQUIPMENT 8" Dia. Hollow Stem Auger

ELEVATION --

DEPTH (FT.)	DEPTH (M)	DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE	DRILL RATE (time/foot)	SPT, N-Value (Blows/ft)	MOISTURE CONTENT, %	DRY DENSITY, lb/cu.ft	LABORATORY TESTS
	6.6					82/9"			
24	7.2								
	7.8								
27	8.4					60/5"			
	9								
30	9.6	very weak from 32'				25			
33	10.2	(no free water encountered)							

Notes:

Relatively undisturbed sample

SPT/Bulk Sample

SPT = Standard Penetration Test based on 63.5 kg (140 lb) hammer free falling 76 cm (30 in.)/blow

LOG OF TEST BORING 2

DATE December 15, 2018

EQUIPMENT 8" Dia. Hollow Stem Auger

ELEVATION --

DEPTH (FT.)	DEPTH (M)	DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE	DRILL RATE (time/foot)	SPT, N-Value (Blows/ft)	MOISTURE CONTENT, %	DRY DENSITY, lb/cu.ft	LABORATORY TESTS
0	0	DARK REDDISH BROWN-WHITE SILTY SANDY LIMESTONE GRAVEL (GM) - medium dense, moist							
		LIGHT BROWN-WHITE CORALLINE LIMESTONE - very weak							
	0.6					10			
3									
	1.2								
6	1.8								
		weak from 7'				45			
	2.4								
9									
	3								
12	3.6	very weak from 12'				14			
	4.2								
15									
	4.8								
						20			
18	5.4								
	6								
21									

GEO-ENGINEERING & TESTING, INC.
Geotechnical & Material Testing Engineers

Job No. 127.05 Date 12/18/18

LOG OF TEST BORING 2

GPA NEW POWER PLANT

DEDEDO, GUAM

PLATE 3

Notes:

Relatively undisturbed sample

SPT/Bulk Sample

SPT = Standard Penetration Test based on 63.5 kg (140 lb) hammer free falling 76 cm (30 in.)/blow

LOG OF TEST BORING 2

DATE December 15, 2018

EQUIPMENT 8" Dia. Hollow Stem Auger

ELEVATION --

DEPTH (FT.)	DEPTH (M)	DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE	DRILL RATE (time/foot)	SPT, N-Value (Blows/ft)	MOISTURE CONTENT, %	DRY DENSITY, lb/cu.ft	LABORATORY TESTS
	6.6								
						16			
	7.2								
24									
	7.8								
27						19			
	8.4								
	9								
		(no free water encountered)							

Notes:

Relatively undisturbed sample

SPT/Bulk Sample

SPT = Standard Penetration Test based on 63.5 kg (140 lb) hammer free falling 76 cm (30 in.)/blow

LOG OF TEST BORING 3

DATE December 15, 2018

EQUIPMENT 8" Dia. Hollow Stem Auger

ELEVATION --

DEPTH (FT.)	DEPTH (M)	DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE	DRILL RATE (time/foot)	SPT, N-Value (Blows/ft)	MOISTURE CONTENT, %	DRY DENSITY, lb/cu.ft	LABORATORY TESTS
0	0	BROWN-WHITE SILTY SANDY LIMESTONE GRAVEL (GM) - medium dense, moist							
		LIGHT BROWN-WHITE CORALLINE LIMESTONE - weak							
	0.6					46			
3									
	1.2								
6	1.8								
		moderately hard from 7'				63			
	2.4								
9									
	3								
12	3.6								
		hard from 12'				7/0"			
	4.2								
15									
	4.8								
		moderately hard from 17'				51			
18	5.4								
	6								
21									

GEO-ENGINEERING & TESTING, INC.
Geotechnical & Material Testing Engineers

Job No. 127.05 Date 12/18/18

LOG OF TEST BORING 3

GPA NEW POWER PLANT

DEDEDO, GUAM

PLATE 4

Notes:

Relatively undisturbed sample

SPT/Bulk Sample

SPT = Standard Penetration Test based on 63.5 kg (140 lb) hammer free falling 76 cm (30 in.)/blow

LOG OF TEST BORING 3

DATE December 15, 2018

EQUIPMENT 8" Dia. Hollow Stem Auger

ELEVATION --

DEPTH (FT.)	DEPTH (M)	DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE	DRILL RATE (time/foot)	SPT, N-Value (Blows/ft)	MOISTURE CONTENT, %	DRY DENSITY, lb/cu.ft	LABORATORY TESTS
	6.6	weak from 22'				46			
24	7.2								
	7.8								
27		hard at 27'				15/0"			
		(no free water encountered)							

Notes:

Relatively undisturbed sample

SPT/Bulk Sample

SPT = Standard Penetration Test based on 63.5 kg (140 lb) hammer free falling 76 cm (30 in.)/blow

LOG OF TEST BORING 4

DATE December 15, 2018

EQUIPMENT 8" Dia. Hollow Stem Auger

ELEVATION --

DEPTH (FT.)	DEPTH (M)	DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE	DRILL RATE (time/foot)	SPT, N-Value (Blows/ft)	MOISTURE CONTENT, %	DRY DENSITY, lb/cu.ft	LABORATORY TESTS
0	0	DARK BROWN-WHITE SILTY SANDY LIMESTONE GRAVEL (GM) - medium dense, moist							
		LIGHT BROWN-WHITE CORALLINE LIMESTONE - weak							
	0.6					34			
3									
	1.2								
6	1.8								
		moderately hard from 7'				83			
	2.4								
9									
	3								
	3.6								
12						86			
	4.2								
15									
	4.8								
						66			
	5.4								
18									
	6								
21									

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Geotechnical & Material Testing Engineers

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LOG OF TEST BORING 4

GPA NEW POWER PLANT

DEDEDO, GUAM

PLATE 5

Notes:

Relatively undisturbed sample

SPT/Bulk Sample

SPT = Standard Penetration Test based on 63.5 kg (140 lb) hammer free falling 76 cm (30 in.)/blow

LOG OF TEST BORING 4

DATE December 15, 2018

EQUIPMENT 8" Dia. Hollow Stem Auger

ELEVATION --

DEPTH (FT.)	DEPTH (M)	DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE	DRILL RATE (time/foot)	SPT, N-Value (Blows/ft)	MOISTURE CONTENT, %	DRY DENSITY, lb/cu.ft	LABORATORY TESTS
	6.6					64			
24	7.2								
	7.8								
27		weak from 27'				38			
	8.4								
	9								
		(no free water encountered)							

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LOG OF TEST BORING 4 (continued)

GPA NEW POWER PLANT

DEDEDO, GUAM

PLATE 5 (cont'd)

Notes:

Relatively undisturbed sample

SPT/Bulk Sample

SPT = Standard Penetration Test based on 63.5 kg (140 lb) hammer free falling 76 cm (30 in.)/blow

LOG OF TEST BORING 5

DATE December 09, 2018

EQUIPMENT 8" Dia. Hollow Stem Auger

ELEVATION --

DEPTH (FT.)	DEPTH (M)	DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE	DRILL RATE (time/foot)	SPT, N-Value (Blows/ft)	MOISTURE CONTENT, %	DRY DENSITY, lb/cu.ft	LABORATORY TESTS
0	0	REDDISH BROWN GRAVELLY SANDY SILT (MH) - medium stiff, moist							
	0.6					6			
3	1.2								
6	1.8								
		LIGHT BROWN-WHITE CORALLINE LIMESTONE - very weak				25			
	2.4								
9	3								
12	3.6	hard from 12'				34/0"			
	4.2								
15	4.8								
		moderately hard from 17'				53			
18	5.4								
	6								
21									

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Geotechnical & Material Testing Engineers

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LOG OF TEST BORING 5

GPA NEW POWER PLANT

DEDEDO, GUAM

PLATE 6

Notes:

Relatively undisturbed sample

SPT/Bulk Sample

SPT = Standard Penetration Test based on 63.5 kg (140 lb) hammer free falling 76 cm (30 in.)/blow

LOG OF TEST BORING 5

DATE December 09, 2018

EQUIPMENT 8" Dia. Hollow Stem Auger

ELEVATION --

DEPTH (FT.)	DEPTH (M)	DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE	DRILL RATE (time/foot)	SPT, N-Value (Blows/ft)	MOISTURE CONTENT, %	DRY DENSITY, lb/cu.ft	LABORATORY TESTS
	6.6					85			
24	7.2								
	7.8								
27	8.4	weak from 27'				33			
	9								
30	9.6	very weak from 32'				25			
33	10.2	(no free water encountered)							

GEO-ENGINEERING & TESTING, INC.
Geotechnical & Materials Testing Services

Job No. 127.05 Date 12/10/18

LOG OF TEST BORING 5 (continued)

GPA NEW POWER PLANT

DEDEDO, GUAM

PLATE 6 (cont'd)

Notes:

Relatively undisturbed sample

SPT/Bulk Sample

SPT = Standard Penetration Test based on 63.5 kg (140 lb) hammer free falling 76 cm (30 in.)/blow

LOG OF TEST BORING 6

DATE December 09, 2018

EQUIPMENT 8" Dia. Hollow Stem Auger

ELEVATION --

DEPTH (FT.)	DEPTH (M)	DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE	DRILL RATE (time/foot)	SPT, N-Value (Blows/ft)	MOISTURE CONTENT, %	DRY DENSITY, lb/cu.ft	LABORATORY TESTS
0	0	DARK REDDISH BROWN SANDY SILT (MH) - soft, moist							
	0.6					4			
3	1.2								
6	1.8								
		medium stiff from 7'				8			
	2.4								
9	3								
		LIGHT BROWN-WHITE CORALLINE LIMESTONE - hard							
12	3.6					48/1"			
	4.2								
15	4.8								
						60/2"			
18	5.4								
	6								
21									

GEO-ENGINEERING & TESTING, INC.
Geotechnical & Material Testing Engineers

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LOG OF TEST BORING 6

GPA NEW POWER PLANT

DEDEDO, GUAM

PLATE 7

Notes:

Relatively undisturbed sample

SPT/Bulk Sample

SPT = Standard Penetration Test based on 63.5 kg (140 lb) hammer free falling 76 cm (30 in.)/blow

LOG OF TEST BORING 6

DATE December 09, 2018

EQUIPMENT 8" Dia. Hollow Stem Auger

ELEVATION --

DEPTH (FT.)	DEPTH (M)	DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE	DRILL RATE (time/foot)	SPT, N-Value (Blows/ft)	MOISTURE CONTENT, %	DRY DENSITY, lb/cu.ft	LABORATORY TESTS
	6.6	weak from 22'				31			
24	7.2								
	7.8								
27	8.4	moderately hard from 27'				73			
	9	(no free water encountered)							

Notes:

Relatively undisturbed sample

SPT/Bulk Sample

SPT = Standard Penetration Test based on 63.5 kg (140 lb) hammer free falling 76 cm (30 in.)/blow

LOG OF TEST BORING 7

DATE December 09, 2018

EQUIPMENT 8" Dia. Hollow Stem Auger

ELEVATION --

DEPTH (FT.)	DEPTH (M)	DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE	DRILL RATE (time/foot)	SPT, N-Value (Blows/ft)	MOISTURE CONTENT, %	DRY DENSITY, lb/cu.ft	LABORATORY TESTS
0	0	REDDISH BROWN SANDY SILT (MH) - medium stiff, moist							
	0.6					6			
3									
	1.2								
6	1.8								
		stiff from 7'				14			
	2.4								
9									
	3								
12	3.6								
		hard from 12'				36			
	4.2								
15									
	4.8								
18	5.4								
		LIGHT BROWN-WHITE CORALLINE LIMESTONE - moderately hard				74			
	6								
21									

GEO-ENGINEERING & TESTING, INC.
Geotechnical & Material Testing Engineers

Job No. 127.05 Date 12/11/18

LOG OF TEST BORING 7

GPA NEW POWER PLANT

DEDEDO, GUAM

PLATE 8

Notes:

Relatively undisturbed sample

SPT/Bulk Sample

SPT = Standard Penetration Test based on 63.5 kg (140 lb) hammer free falling 76 cm (30 in.)/blow

LOG OF TEST BORING 7

DATE December 09, 2018

EQUIPMENT 8" Dia. Hollow Stem Auger

ELEVATION --

DEPTH (FT.)	DEPTH (M)	DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE	DRILL RATE (time/foot)	SPT, N-Value (Blows/ft)	MOISTURE CONTENT, %	DRY DENSITY, lb/cu.ft	LABORATORY TESTS
	6.6	hard from 22'				60/5"			
24	7.2								
	7.8								
27	8.4					34/1"			
	9								
30	9.6					30/0"			
33	10.2	(no free water encountered)							

GEO-ENGINEERING & TESTING, INC.
Geotechnical & Materials Testing Services

Job No. 127.05 Date 12/11/18

LOG OF TEST BORING 7 (continued)

GPA NEW POWER PLANT

DEDEDO, GUAM

PLATE 8 (cont'd)

Notes:

Relatively undisturbed sample

SPT/Bulk Sample

SPT = Standard Penetration Test based on 63.5 kg (140 lb) hammer free falling 76 cm (30 in.)/blow

LOG OF TEST BORING 8

DATE December 08, 2018

EQUIPMENT 8" Dia. Hollow Stem Auger

ELEVATION --

DEPTH (FT.)	DEPTH (M)	DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE	DRILL RATE (time/foot)	SPT, N-Value (Blows/ft)	MOISTURE CONTENT, %	DRY DENSITY, lb/cu.ft	LABORATORY TESTS
0	0	DARK BROWN GRAVELLY SANDY SILT (MH) - medium stiff, moist							
	0.6	LIGHT BROWN-WHITE CORALLINE LIMESTONE - weak				31			
3	1.2								
	1.8								
6						35			
	2.4								
9	3								
	3.6								
12						40			
	4.2								
15	4.8								
						30			
18	5.4								
	6								
21									

GEO-ENGINEERING & TESTING, INC.
Geotechnical & Material Testing Engineers

Job No. 127.05 Date 12/11/18

LOG OF TEST BORING 8

GPA NEW POWER PLANT

DEDEDO, GUAM

PLATE 9

Notes:

Relatively undisturbed sample

SPT/Bulk Sample

SPT = Standard Penetration Test based on 63.5 kg (140 lb) hammer free falling 76 cm (30 in.)/blow

LOG OF TEST BORING 8

DATE December 08, 2018

EQUIPMENT 8" Dia. Hollow Stem Auger

ELEVATION --

DEPTH (FT.)	DEPTH (M)	DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE / DRILL RATE (time/foot)	SPT, N-Value (Blows/ft)	MOISTURE CONTENT, %	DRY DENSITY, lb/cu.ft	LABORATORY TESTS
	6.6	moderately hard from 22'			68			
24	7.2							
	7.8							
27		weak from 27'			41			
	8.4							
	9							
30								
	9.6				42			
33	10.2	(no free water encountered)						

GEO-ENGINEERING & TESTING, INC.
Geotechnical & Materials Testing Services

Job No. 127.05 Date 12/11/18

LOG OF TEST BORING 8 (continued)

GPA NEW POWER PLANT

DEDEDO, GUAM

PLATE 9 (cont'd)

Notes:

Relatively undisturbed sample

SPT/Bulk Sample

SPT = Standard Penetration Test based on 63.5 kg (140 lb) hammer free falling 76 cm (30 in.)/blow

LOG OF TEST BORING 9

DATE December 08, 2018

EQUIPMENT 8" Dia. Hollow Stem Auger

ELEVATION --

DEPTH (FT.)	DEPTH (M)	DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE	DRILL RATE (time/foot)	SPT, N-Value (Blows/ft)	MOISTURE CONTENT, %	DRY DENSITY, lb/cu.ft	LABORATORY TESTS
0	0	DARK BROWN SANDY SILT (MH) - soft, moist							
		LIGHT BROWN-WHITE SILTY SANDY LIMESTONE GRAVEL (GM) - medium dense, moist							
	0.6					13			
3	1.2								
	1.8								
6						24			
	2.4								
9	3	LIGHT BROWN-WHITE CORALLINE LIMESTONE - very weak							
	3.6								
12						20			
	4.2								
15	4.8								
		moderately hard from 17'				68			
18	5.4								
	6								
21									

GEO-ENGINEERING & TESTING, INC.
Geotechnical & Material Testing Engineers

Job No. 127.05 Date 12/11/18

LOG OF TEST BORING 9

GPA NEW POWER PLANT

DEDEDO, GUAM

PLATE 10

Notes:

Relatively undisturbed sample

SPT/Bulk Sample

SPT = Standard Penetration Test based on 63.5 kg (140 lb) hammer free falling 76 cm (30 in.)/blow

LOG OF TEST BORING 9

DATE December 08, 2018

EQUIPMENT 8" Dia. Hollow Stem Auger

ELEVATION --

DEPTH (FT.)	DEPTH (M)	DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE	DRILL RATE (time/foot)	SPT, N-Value (Blows/ft)	MOISTURE CONTENT, %	DRY DENSITY, lb/cu.ft	LABORATORY TESTS
	6.6	hard from 22'				70/9"			
24	7.2								
	7.8								
27	8.4	weak from 27'				42			
	9								
		(no free water encountered)							

GEO-ENGINEERING & TESTING, INC.
Geotechnical & Materials Testing Services

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LOG OF TEST BORING 9 (continued)

GPA NEW POWER PLANT

DEDEDO, GUAM

PLATE 10 (cont'd)

Notes:

Relatively undisturbed sample

SPT/Bulk Sample

SPT = Standard Penetration Test based on 63.5 kg (140 lb) hammer free falling 76 cm (30 in.)/blow

LOG OF TEST BORING 10

DATE December 08, 2018

EQUIPMENT 8" Dia. Hollow Stem Auger

ELEVATION --

DEPTH (FT.)	DEPTH (M)	DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE	DRILL RATE (time/foot)	SPT, N-Value (Blows/ft)	MOISTURE CONTENT, %	DRY DENSITY, lb/cu.ft	LABORATORY TESTS
0	0	DARK BROWN SANDY SILT (MH) - soft, moist							
	0.6	dark reddish brown, very stiff from 2'				23			
3	1.2								
6	1.8	LIGHT BROWN-WHITE CORALLINE LIMESTONE - hard				97/8"			
	2.4								
9	3								
12	3.6	moderately hard from 12'				55			
	4.2								
15	4.8								
						81			
18	5.4								
	6								
21									

GEO-ENGINEERING & TESTING, INC.
Geotechnical & Material Testing Engineers

Job No. 127.05 Date 12/11/18

LOG OF TEST BORING 10

GPA NEW POWER PLANT

DEDEDO, GUAM

PLATE 11

Notes:

Relatively undisturbed sample

SPT/Bulk Sample

SPT = Standard Penetration Test based on 63.5 kg (140 lb) hammer free falling 76 cm (30 in.)/blow

LOG OF TEST BORING 10

DATE December 08, 2018

EQUIPMENT 8" Dia. Hollow Stem Auger

ELEVATION --

DEPTH (FT.)	DEPTH (M)	DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE / DRILL RATE (time/foot)	SPT, N-Value (Blows/ft)	MOISTURE CONTENT, %	DRY DENSITY, lb/cu.ft	LABORATORY TESTS
	6.6	weak from 22'			48			
24	7.2							
	7.8							
27	8.4				36			
	9	(no free water encountered)						

GEO-ENGINEERING & TESTING, INC.
Geotechnical & Materials Testing Services

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LOG OF TEST BORING 10 (continued)

GPA NEW POWER PLANT

DEDEDO, GUAM

PLATE 11 (cont'd)

Notes:

Relatively undisturbed sample

SPT/Bulk Sample

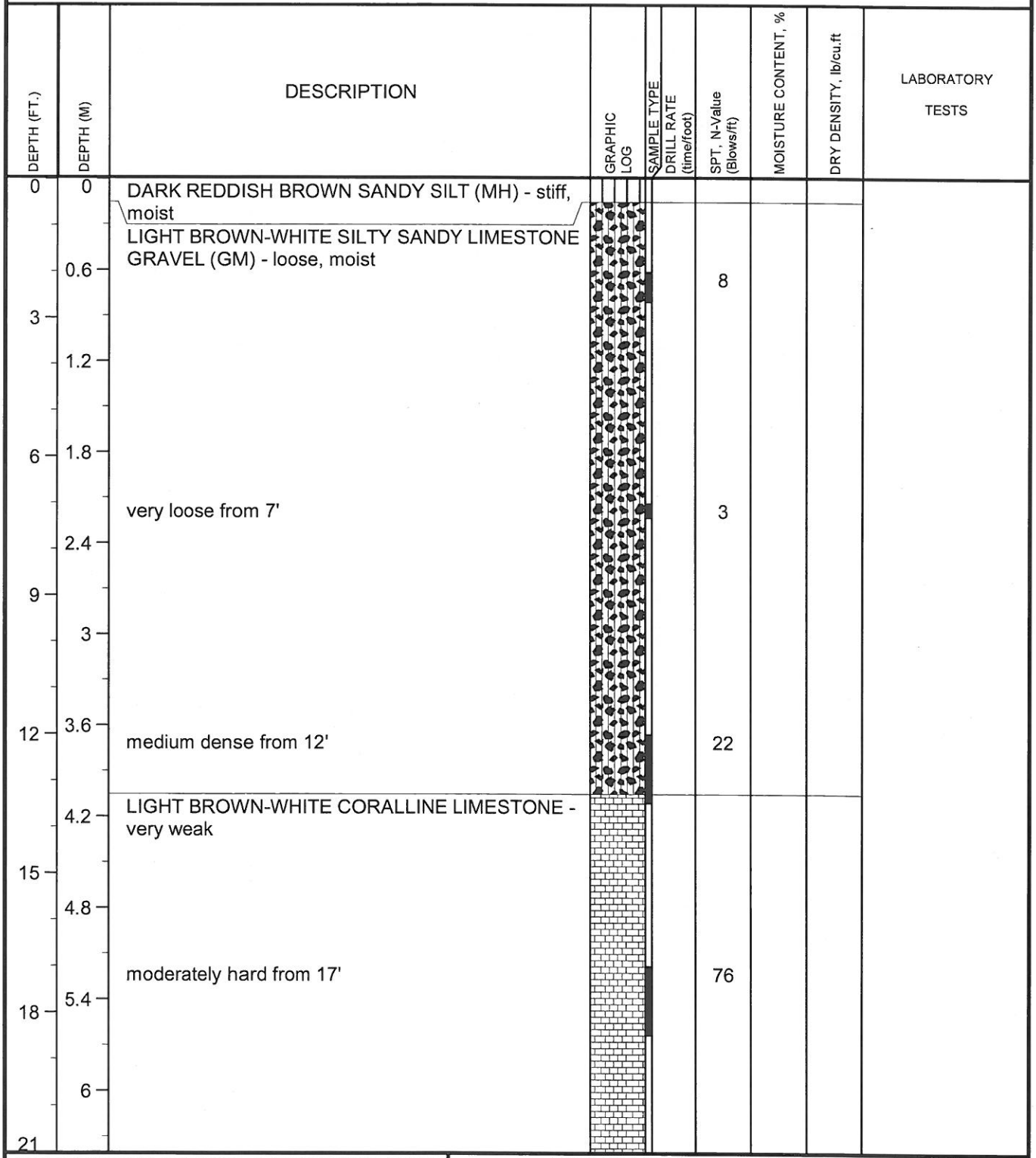
SPT = Standard Penetration Test based on 63.5 kg (140 lb) hammer free falling 76 cm (30 in.)/blow

LOG OF TEST BORING 11

DATE December 08, 2018

EQUIPMENT 8" Dia. Hollow Stem Auger

ELEVATION --



GEO-ENGINEERING & TESTING, INC.
Geotechnical & Material Testing Engineers

Job No. 127.05 Date 12/11/18

LOG OF TEST BORING 11

GPA NEW POWER PLANT

DEDEDO, GUAM

PLATE 12

Notes:

Relatively undisturbed sample

SPT/Bulk Sample

SPT = Standard Penetration Test based on 63.5 kg (140 lb) hammer free falling 76 cm (30 in.)/blow

LOG OF TEST BORING 11

DATE December 08, 2018

EQUIPMENT 8" Dia. Hollow Stem Auger

ELEVATION --

DEPTH (FT.)	DEPTH (M)	DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE / DRILL RATE (time/foot)	SPT, N-Value (Blows/ft)	MOISTURE CONTENT, %	DRY DENSITY, lb/cu.ft	LABORATORY TESTS
	6.6				69			
24	7.2							
	7.8							
27	8.4				73			
	9	(no free water encountered)						

GEO-ENGINEERING & TESTING, INC.
Geotechnical & Materials Testing Services

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LOG OF TEST BORING 11 (continued)

GPA NEW POWER PLANT

DEDEDO, GUAM

PLATE 12 (cont'd)

Notes:

Relatively undisturbed sample

SPT/Bulk Sample

SPT = Standard Penetration Test based on 63.5 kg (140 lb) hammer free falling 76 cm (30 in.)/blow

LOG OF TEST BORING 12

DATE December 09, 2018

EQUIPMENT 8" Dia. Hollow Stem Auger

ELEVATION --

DEPTH (FT.)	DEPTH (M)	DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE	DRILL RATE (time/foot)	SPT, N-Value (Blows/ft)	MOISTURE CONTENT, %	DRY DENSITY, lb/cu.ft	LABORATORY TESTS
0	0	DARK REDDISH BROWN SANDY SILT (MH) - medium stiff, moist							
	0.6	LIGHT BROWN-WHITE CORALLINE LIMESTONE - hard				41/5"			
3	1.2								
6	1.8	very weak from 7'				20			
	2.4								
9	3								
12	3.6	weak from 12'				49			
	4.2								
15	4.8								
		hard from 17'				20/0"			
18	5.4								
	6								
21									

GEO-ENGINEERING & TESTING, INC.
Geotechnical & Material Testing Engineers

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LOG OF TEST BORING 12

GPA NEW POWER PLANT

DEDEDO, GUAM

PLATE 13

Notes:

Relatively undisturbed sample

SPT/Bulk Sample

SPT = Standard Penetration Test based on 63.5 kg (140 lb) hammer free falling 76 cm (30 in.)/blow

LOG OF TEST BORING 12

DATE December 09, 2018

EQUIPMENT 8" Dia. Hollow Stem Auger

ELEVATION --

DEPTH (FT.)	DEPTH (M)	DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE	DRILL RATE (time/foot)	SPT, N-Value (Blows/ft)	MOISTURE CONTENT, %	DRY DENSITY, lb/cu.ft	LABORATORY TESTS
	6.6					30/0"			
24	7.2								
	7.8								
27	8.4					30/0"			
	9								
		(no free water encountered)							

GEO-ENGINEERING & TESTING, INC.
Geotechnical & Materials Testing Services

Job No. 127.05 Date 12/11/18

LOG OF TEST BORING 12 (continued)

GPA NEW POWER PLANT

DEDEDO, GUAM

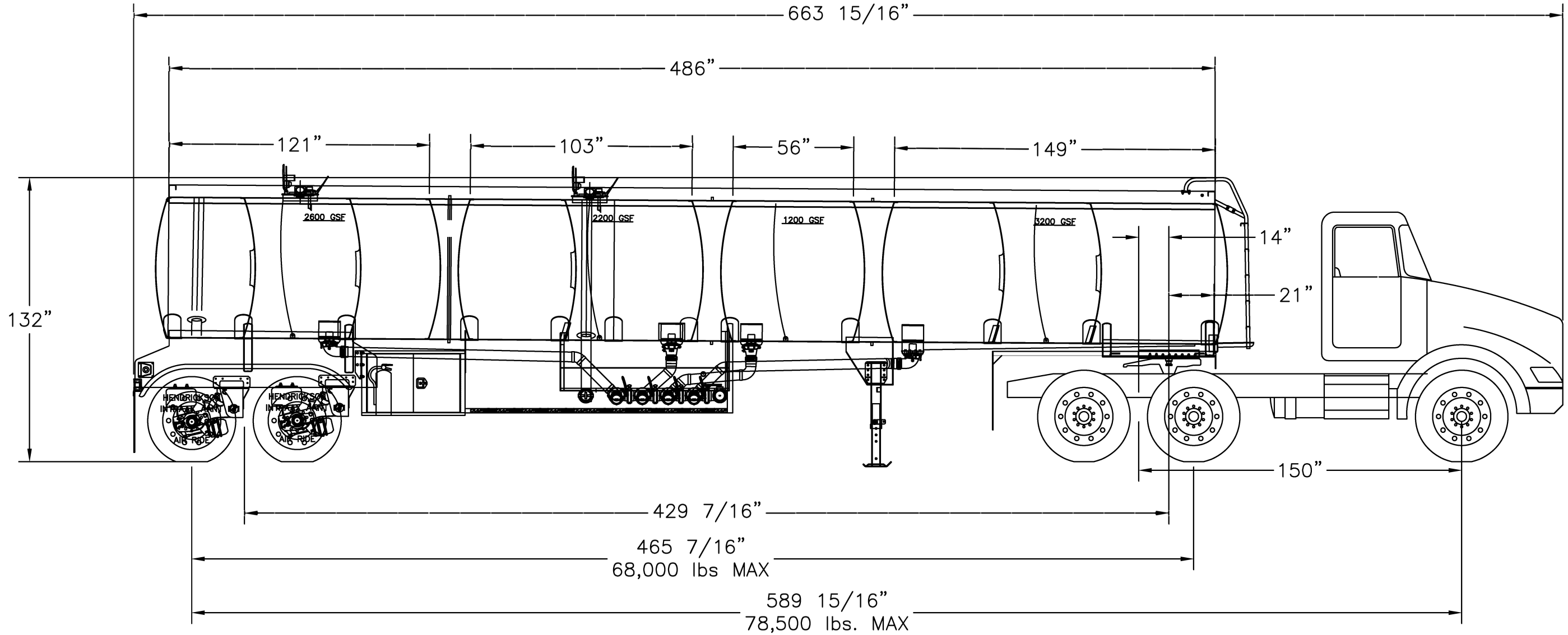
PLATE 13 (cont'd)

MAJOR DIVISIONS			SYMBOL		TYPICAL NAMES
COARSE GRAINED SOILS (MORE THAN HALF IS LARGER THAN # 200 SIEVE)	GRAVELS (MORE THAN HALF COARSE FRACTION IS LARGER THAN No. 4 SIEVE SIZE)	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW		WELL GRADED GRAVELS, GRAVEL - SAND MIXTURES
			GP		POORLY GRADED GRAVELS, GRAVEL - SAND MIXTURES
		GRAVELS WITH OVER 12 % FINES	GM		SILTY GRAVELS, POORLY GRADED GRAVEL - SAND - SILT MIXTURES
			GC		CLAYEY GRAVELS, POORLY GRADED GRAVEL - SAND - CLAY MIXTURES
	SANDS (MORE THAN HALF COARSE FRACTION IS SMALLER THAN No. 4 SIEVE SIZE)	CLEAN SANDS WITH LITTLE OR NO FINES	SW		WELL GRADED SANDS, GRAVELLY SANDS
			SP		POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 12 % FINES	SM		SILTY SANDS, POORLY GRADED SAND - SILT MIXTURES
			SC		CLAYEY SANDS, POORLY GRADED SAND - CLAY MIXTURES
FINE GRAINED SOILS (MORE THAN HALF IS SMALLER THAN # 200 SIEVE)	SILTS AND CLAYS (LIQUID LIMIT LESS THAN 50)		ML		INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILT WITH SLIGHT PLASTICITY
			CL		INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL		ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (LIQUID LIMIT GREATER THAN 50)		MH		INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH		ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			Pt		PEAT AND OTHER HIGHLY ORGANIC SOILS

SOIL CLASSIFICATION SYSTEM

■ UNDISTURBED SAMPLE ☒ DISTURBED SAMPLE

GEO-ENGINEERING & TESTING, INC. Geotechnical & Material Testing Engineers	**SOIL CLASSIFICATION CHART AND KEY TO TEST DATA** GPA NEW POWER PLANT DEDEDO GUAM	**PLATE** **14**
Job No. 127.05 Appr. US/ Date: 12/11/18		



ESTIMATED WEIGHTS (EST. ±3%, GUAM)

TARE	TANDEM	TOTAL	DRIVER	STEER
PAYLOAD	6,580	24,430	9,585	8,265
TOTAL	27,285	54,070	24,285	2,500
	33,865	78,500	33,870	10,765

NOTES:
1. TRUCK WEIGHT INCLUDES DRIVER AND FUEL, WEIGHTS PER 13 AUG 2015 DRAFT SPECS
2. TRUCK WEIGHT DOES NOT INCLUDE OPTION NOT LIST IN SPECS
3. DIESEL MAX PAYLOAD DIESEL 7,509 GAL @ 7.2 LB/GAL; GASOLINE 8,721 GAL @ 6.2 LB/GAL
4. WEIGHT ESTIMATES ±3%

SUBJECT		PROJECT				
XX. /		APPROVALS	DATE			
MATERIAL		ENGR				
FINISH	APPROX WEIGHT	CHECKED		SHEET 1 OF 1	SCALE	REV 03

SOURCE TANK

BAY 1
LOADING ARM

BAY 2
LOADING ARM

ACCULOAD SYSTEM
Rated capacity: 435gpm

SUPPLY PIPELINE

TRISTAR TRUCK LOADING/ GANTRY (SKID-MOUNTED)

TRUCK RAMP


TRUCK IN
TO
BAY 1
TRUCK IN
TO
BAY 2
TRUCK OUT
FROM
BAY1
TRUCK OUT
FROM
BAY2

SECTION 11Q

POTENTIAL TRANSFORMERS

1.01 GENERAL. Potential transformers (PTs) shall be furnished in accordance with this section and as indicated on the drawings.

1.02 CODES AND STANDARDS. All equipment furnished under these specifications shall conform to the applicable standards of ANSI, IEEE, and NEMA.

All materials and devices shall be in accordance with the applicable requirements of the Federal "Occupational Safety and Health Standards."

1.03 EQUIPMENT REQUIRED. The quantity of PTs provided shall be as indicated on the drawings.

1.04 RATINGS. All PTs shall be suitable for operation at the altitude and shall be rated as indicated on the Specification Data Sheets.

1.05 DETAILS OF CONSTRUCTION. The PTs shall be single bushing type, designed and fabricated in accordance with the applicable requirements of ANSI C57.13 and NEMA EI2.

Porcelain color shall be in accordance with the Specification Data Sheets.

Each PT shall be furnished with a 4-in. wide NEMA 4-hole line terminal pad, unless otherwise indicated on the Specification Data Sheets.

PTs shall be furnished with all field connection hardware for field mounting on steel supports described in these specifications. All hardware shall be hot-dip galvanized.

The PTs shall be furnished with the following accessories:

Ground conductor--NEMA 2-hole ground pad, clamp type, Range 6 AWG-250 kcmil.

Oil level indicator.

Oil drain and filling valves.

Four lifting eyes in base.

1.06 MANUFACTURERS. PTs shall be of the manufacturer and type indicated on the Specification Data Sheets.

1.07 SPECIFICATION DATA SHEET

Potential transformers (PTs) shall be furnished in accordance with the following:

LOCATION AND QUANTITY.

Substation Name

Hagatna 115 kV and 34.5 kV Breaker Replacement

RATINGS

Nominal voltage, kV (line-to-line)	115
Nominal voltage, kV (line-to-ground)	66.4
BIL, kV	550
Frequency, Hz	60
Number of secondary windings	2
Ratio (primary: secondary)	600-1000:1
Secondary voltage, V	66.4/110
Altitude, ft	3300ft
ANSI accuracy class	0.3W, X, Y, Z, ZZ
Space heater rated voltage, VAC (if provided)	240
Space heater applied voltage, VAC (if provided)	120

Porcelain color: _X_ ANSI 70 grey,___ Brown

Porcelain minimum creepage distance, inch/kV	1inch/kV

Line terminal pad: 4-hole NEMA pad

PT MANUFACTURER

ABB
General Electric
Trench Electric

1.07 SPECIFICATION DATA SHEET (continued)

LOCATION AND QUANTITY.

Substation Name

Hagatna 115 kV and 34.5 kV Breaker Replacement

RATINGS

Nominal voltage, kV (line-to-line)	34.5
Nominal voltage, kV (line-to-ground)	20
BIL, kV	200
Frequency, Hz	60
Number of secondary windings	2
Ratio (primary:secondary)	175-300:1
Secondary voltage, V	66.4/110
Altitude, ft	3300ft
ANSI accuracy class	0.3W, X, Y, Z, ZZ
Space heater rated voltage, VAC (if provided)	240
Space heater applied voltage, VAC (if provided)	120
Porcelain color: _X_ ANSI 70 grey,___ Brown	
Porcelain minimum creepage distance, inch/kV	1inch/kV
Line terminal pad: 4-hole NEMA pad	

PT MANUFACTURER

ABB
General Electric
Trench Electric

END OF SECTION 11Q

INVITATION TO BID NO: GPA-
GPA PROJECT NO: E-100110

DEDEDO INDOOR SUBSTATION

JOVEN G. ACOSTA, P.E.
Manager of Engineering

MELINDA R. CAMACHO, P.E.
Assistant General Manager of Operations

JOAQUIN C. FLORES, P.E.
General Manager

May 15, 2013

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DEDEDO INDOOR SUBSTATION

GPA PROJECT NO. E-100110

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INVITATION TO BID

The Governor of Guam, Edward J.B. Calvo, through the Guam Power Authority is soliciting for the Dededo Indoor Substation, GPA Project No. E-100110. Sealed bids will be received at the Guam Power Authority, Procurement Office until 2:00 p.m. _____. Bids will be publicly opened In the Procurement Conference Room, 1st Floor, GPA Main Office Building.

Contract time is five hundred fifty (550) calendar days. All bids must be accompanied by a bid security in the amount of 15% of the total bid amount. Bid security may be bid bond, certified check or cashier's check made payable to the Guam Power Authority.

The right is reserved to reject any or all bids and to waive any imperfection in the bids in the interest of the Government of Guam.

A pre-bid conference will be held on_____ at 9:00 a.m. at the Procurement Conference Room, Guam Power Authority. A site investigation will be held thereafter. All prospective bidders are requested to be present at both the pre-bid conference and the site investigation.

INSTRUCTIONS TO BIDDERS

1. RECEIPT AND OPENING OF BIDS

Interested parties shall submit two (2) copies and one (1) original of their sealed bids for the Dededo Indoor Substation. Sealed bids will be received by the Guam Power Authority at the Procurement Office until 2:00 p.m., _____. Bids will be publicly opened and read aloud shortly afterwards in the GPA Procurement Office, 1st Floor, GPA Main Office Building.

Bids shall be made on the forms furnished by the Guam Power Authority and shall be enclosed in a sealed envelope addressed to the General Manager of Guam Power Authority, Government of Guam, and endorsed with the name of the bidder and the title "Dededo Indoor Substation, GPA Project No.E-100110."

Attention is called to the fact that bidders not only offer to assume the obligations and liabilities imposed upon the Contractor in the form of contract, but expressly make certain of the representations and warrants made therein. No effort is made to emphasize any particular provision of the contract, but bidders must familiarize themselves with every provision and its effect.

2. TIME OF COMPLETION

The Contractor shall commence work on the date specified in the Notice to Proceed and shall complete all work within five hundred fifty (550) calendar days, complete and ready for use. In the event the Contractor does not complete the work within the time specified, liquidated damages will be assessed as stated in Section 5 of the Special Provisions.

3. PLANS AND SPECIFICATIONS

Plans, specifications and bid forms may be obtained at the Procurement Office, Guam Power Authority for the purchase price of $250.00 for each set. There will be no refunds.

This invitation for bid consists of the following documents:

a) Bid Invitation Documents

1. Invitation to Bid
2. Instructions to Bidders

b) Bid Submittal Documents

1. Bid
2. Bid Form
3. Bid Bond
4. Non-Collusion Affidavit
5. Listing of Subcontractors
6. Major Shareholders Disclosure Affidavit
7. Contract

c) Contract Documents

1. Formal Contract
2. Performance and Payment Bonds
3. Special Provisions
4. General Conditions
5. General Scope of Work
6. Prevailing Wage Rates
7. Technical Specifications
8. Plans

4. PREPARATION OF BID

The bidder must submit his bid on the forms furnished by the Guam Power Authority. All blank spaces in the bid forms must be correctly filled in where indicated and the bidder must state the prices (both in words and numerals) for which he proposes to do each item of the work contemplated or furnish each item of the materials required. In case of conflict between words and numerals, the words, unless obviously incorrect, will govern.

The bidder shall sign his bid in the blank space provided therefore. If this bid is made by a partnership or corporation, the name and address of the partnership or corporation shall be shown, together with the names and addresses of the partners or officers. If the bid is made by a partnership, it must be acknowledged by one of the partners, if made by a corporation by one of the authorized officers thereof.

5. BID SECURITY

Each bid must be accompanied by a deposit in the amount of not less than fifteen percent (15%) of the highest bid price for which award can be made. Such deposit may be in the form of a bid bond, cashier's check or certified check made payable to the Guam Power Authority. Should the successful bidder fail or refuse to execute and deliver the contract and performance and payment bonds required within ten (10) working days after acceptance of his bid by the Government, he shall forfeit to the Government of Guam as liquidated damages for such failure or refusal the security deposited with his bid.

6. NON-COLLUSION AFFIDAVIT

Each person submitting a bid for any portion of the work covered by the bid documents shall execute an affidavit, in the form provided with the bid, to the effect that he has not colluded with any other person, firm or corporation in regards to any bid submitted. Such affidavit shall be attached to the bid.

7. RIGHT TO ACCEPT AND REJECT BIDS

The Government of Guam reserves the unqualified right, in its sole and absolute discretion, to reject any and all bids, or to accept that bid or combination of bids, if any, which in its sole and absolute judgment will under all circumstances best serve the Government's interests. In the event that the successful bidder fails to execute the contract upon his part or to furnish a satisfactory performance and payment bond, the Government, after declaring forfeited the security deposit of such bidder, reserves the option to accept the bid of any other bidder within ten (10) calendar days from such default, in which case such acceptance shall have the same effect as to such bidder as though he was the originally successful bidder.

8. METHOD OF AWARD

a) The Government estimate will be recorded prior to bid opening and announcement will be made after all bids are opened.

b) Bidding procedure involving base bid and additive bid items:

If the total of the base bid items is within the amount of funds available to finance the construction contract and the Government wishes to accept any of the additive bid items, then contract award will be made to that responsible bidder submitting the lowest responsive combined bid consisting of the base bid items plus additive bid items within available funding.

9. COMPETENCY OF BIDDERS

The Government may require bidders to present satisfactory evidence that he has sufficient experience and he is fully prepared with necessary capital, material, machinery and skilled workmen and supervision staff to carry out the contract satisfactorily.

Accordingly, the Contractor must submit for review the following statements upon request:

a) Experience on similar work.
b) Past performance of firm in accomplishing government projects in agreed time.
c) Availability of plant, machinery and other equipment necessary for work.
d) Quality of work presently performed for Government of Guam or other agencies.
e) Contractor's diligence in carrying out responsibility.
f) Record of good owner-contractor relationship.

g) Previous record of bids qualification.
h) Quality of supervisory personnel and areas of their performance.
i) Record of past performance of government contracts including record of default and nonpayment of obligations.
j) Possession of Government of Guam appropriate contractor's license.
k) Financial resources.

Financial resources report shall be dated not more than six (6) months prior to bid opening, must be prepared by a certified accountant and shall contain at least the following information:

a) Total Assets
b) Total Liabilities
c) Total Current Assets
d) Total Current Liabilities
e) Bonding Capability

Any bidder who at the time of bidding is determined liable to pay liquidated damages for delay in completion of the last two works contracted from the Government of Guam will be automatically rejected.

10. MODIFICATIONS PRIOR TO DATE SET FOR OPENING BIDS

The right is reserved, as the interest of the Government may require, to revise the specifications or drawings or both prior to the date set for opening bids. Such revisions, if any, will be announced by an addendum or addenda to this invitation for bid. If the addenda are of a nature which requires material changes in quantities or prices to be bid or both, the date set for opening bids may be postponed by such number of days as in the opinion of the issuing officer will enable bidders to revise their bids. In such cases, the addendum will include an announcement of the new date for opening bids.

11. REPRESENTATION REGARDING GRATUITIES AND KICKBACKS

The bidder, offeror or contractor represents that it has not violated, is not violating, and promises that it will not violate the prohibition against gratuities and kickbacks set forth in Section 11-206 (Gratuities and Kickbacks) of the Guam Procurement Regulations.

12. REPRESENTATION REGARDING ETHICAL STANDARDS FOR GOVERNMENT EMPLOYEES AND FORMER GOVERNMENT EMPLOYEES

The bidder, offeror or contractor represents that it has not knowingly influenced and promises that it will not knowingly influence a government employee to breach any of the ethical standards set forth in Chapter 11 (Ethics in Public Contracting) of the Guam Procurement Act.

13. DISCLOSURE OF MAJOR SHAREHOLDERS:

a) As a condition of bidding, any partnership, sole proprietorship or corporation doing business with the Government of Guam shall submit an affidavit executed under oath that lists the name and address of any person who has held more than ten percent (10%) of the outstanding interest or shares in said partnership, sole proprietorship or corporation at any time during the twelve (12)-month period immediately preceding submission of a bid. The affidavit shall contain the number of shares or the percentage of all assets of such partnership, sole proprietorship or corporation which have been held by each such person during the twelve (12)-month period. In addition, the affidavit shall contain the name and address of any person who has received or is entitled to receive a commission, gratuity or other compensation for procuring or assisting in obtaining business related to the bid for the bidder and shall also contain the amounts of any such commission, gratuity or other compensation. The affidavit shall be open and available to the public for inspection and copying.

b) Failure by any bidder to submit the Major Shareholders Disclosure Affidavit or the Non-Collusion Affidavit shall result in the disqualification of his bid.

BID FORM

Date:

To: Guam Power Authority
GPA Main Office Building
1911 Army Drive Route 16 Tamuning, Guam 96913-1255

Gentlemen:

The undersigned (hereafter called the Bidder), a _____
_____
(Corporation, Partnership or Individual)
organized and/or licensed to do business under the laws of _____, hereby proposes and agrees to furnish all the necessary labor, materials, equipment, tools and services necessary for the _____
_____
all in accordance with the drawings, specifications and other contract documents prepared by the Guam Power Authority for the sum of _____
($ _____) plus any and all sums to be added and/or deducted resulting from all extra and/or omitted work in accordance with the unit and/or lump sum prices stated in the itemized bid form attached hereto.

The undersigned has examined the location of the proposed work, the drawings, specifications and other contract documents and is familiar with the local conditions at the place where the work is to be performed.

The bid security attached, without endorsement, in the sum of not less than fifteen percent (15%) of the amount of the bid, is furnished to the Guam Power Authority as a guarantee that the contract will be executed and a performance and payment bond furnished within fourteen (14) days after the acceptance of the bid of the undersigned. In the event that the undersigned bidder shall fail to execute the contract and furnish a satisfactory performance and payment bond under the conditions and within the time specified in this bid, the bid security shall be forfeited as liquidated damages for the delay and additional work and costs caused thereby in obtaining another bidder, said being beforehand determined as being reasonable and containing no penalties.

If written notice of the acceptance of this bid is mailed, telegraphed or delivered to the undersigned within sixty (60) days after the opening thereof, the undersigned agrees to execute the form of agreement included as one of the contract documents, and to furnish a performance and payment bond in an amount equal to one hundred percent (100%) of the contract amount within fourteen (14) working days after receipt of such notice.

FORM OF NON-COLLUSION AFFIDAVIT

A F F I D A V I T

(Prime Bidder)

TERRITORY OF GUAM)
)ss
HAGATÑA, GUAM M.I.)

_____, being first duly sworn, deposes and says:

That he is _____
(a partner or officer of the firm of, etc.)
the party making the foregoing bid, that such bid is genuine and not collusive or sham, that said bidder has not colluded, conspired, connived or agreed, directly or indirectly, with any bidder or person, to put in a sham bid or to refrain from bidding, and has not in any manner, directly or indirectly, sought by an agreement or collusion, or communication or conference, with any person to fix the bid price of affiant or of any other bidder, or to fix any overhead, profit or cost element of said bid price, or of that of any other bidder, or to secure any advantage against the Guam Power Authority or any other bidder, or to secure any advantage against the Guam Power Authority or any person interested in the proposed contract; and that all statements in bid are true.

_____
Signature of

Bidder, if the bidder is an individual;
Partner, if the bidder is a partnership;
Officer, if the bidder is a corporation.

Subscribed and sworn to before me

this _____ day of _____, _____.

_____
NOTARY PUBLIC
My commission expires _____, _____.

SPECIAL PROVISION FOR MAJOR SHAREHOLDERS DISCLOSURE AFFIDAVIT

All Bidders/Offerors are required to submit a current affidavit as required below. Failure to do so will mean disqualification and rejection of the bid.

Excerpt from P.L. 18-44:

Section 44. A new section 6961.3 is added to the Government Code to read.

Section 6961.3 Disclosure of Major Shareholders. As a condition of bidding, any partnership, sole proprietorship or corporation doing business with the Government of Guam shall submit an affidavit executed under oath that lists the name and address of any person who has held more than ten percent (10%) of outstanding interest or shares in said partnership, sole proprietorship or corporation at any time during the twelve (12) month period immediately preceding submission of a bid. The affidavit shall contain the number of shares or the percentage or all assets of such partnership, sole proprietorship or corporation which have been held by each such person during the twelve (12) month period. In addition, the affidavit shall contain the amounts of any such commission, gratuity or other compensation. The affidavit shall be open and available to the public for inspection and copying.

1. If the affidavit is a copy, indicate the BID/RFP number and where it is filed.

2. Affidavits must be signed within 60 days of the date the bids or proposals are due.

MAJOR SHAREHOLDERS DISCLOSURE AFFIDAVIT

TERRITORY OF GUAM)
)ss.
HAGATÑA, GUAM)

I, the undersigned, _____, being first

(a partner or officer of the company of, etc.)

duly sworn, deposes and says:

1. That the persons who have held more than ten percent (10%) of the company's shares during the past twelve months are as follows:

Name	Address	Percentage of Shares Held
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
	Total Number of Shares:	_____

2. Persons who have received or are entitled to receive a commission, gratuity or other compensation for procuring or assisting in obtaining business related to the bid for which this Affidavit is submitted are as follows:

Name	Address	Amount of Commission Gratuity or Other Compensation

Further, affiant sayeth naught.

Date: _____

_____
Signature of individual if bidder is a sole proprietorship; Partner, if the bidder is a partnership; Officer, if the bidder is a corporation.

Subscribed and sworn to before me this _____ day of _____, _____.

By: _____
Notary Public _____
In and for the Territory of Guam
My commission expires _____

DEDEDO INDOOR SUBSTATION
GPA PROJECT NO. E-100110

I. BASE BID ITEMS

Bid Item	Description	Qty	Unit	Total Cost
A1	Mobilization/Demobilization	1	LS	_____
A2	Concrete Pavement	1	LS	_____
A3	Chain Link Fence	1	LS	_____
A4	Control Building	1	LS	_____
A5	Oil Containment System and Drainage System	1	LS	_____
A6	Installation of Power Transformer	1	LS	_____
A7	Control Cables and Wiring	1	LS	_____
A8	Underground Conduits and Conduit Risers	1	LS	_____
A9	Manholes	1	LS	_____
A10	Power Cables 34.5 kV	1	LS	_____
A11	Power Cables 13.8 kV	1	LS	_____
A12	13.8 kV Switchgear	1	LS	_____
A13	34.5 kV Switchgear	1	LS	_____
A14	SCADA System	1	LS	_____
A15	Electrical Testing	1	LS	_____
A16	Grounding and Lightning Protection System	1	LS	_____
A17	Testing for Soil Contamination	1	LS	_____
			TOTAL	

II. ADDITIVE BID OPTIONS

Bid Item	Description	Qty	Unit		Total Cost
B1	Removal and Disposal of Contaminated Soil from Base Bid Construction Area	1	LS		_____
	Per unit cost	1	CY	_____	
B2	Demolition and Disposal of Existing Switchyard Equipment	1	LS		_____
B3	Removal and Disposal of Contaminated Soil from the Switchyard Area	1	LS		_____
	Per unit cost	1	CY	_____	
B4	Work Related to Mobile Substation a) Grading b) Concrete Pavement c) Sliding Gate d) 34.5 kV Disconnect Switch e) 13.8 kV Disconnect Switch f) Riser Structures g) Grounding System h) Lightning Protection System i) 6" Crushed Coral Surface	1	LS		_____
B5	Removal and Disposal of Contaminated Soil from the Mobile Substation Pad Area	1	LS		_____
	Per unit cost	1	CY	_____	
				TOTAL	_____

Note: Referenced drawing numbers and specification sections are for ease of reference only and do not limit applicability of other drawings and specifications as it relates to the particular bid items. GPA reserves the right to award the bid based on the Base Bid and any combination of the Additive Bid Options.

BOND NO.

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that _____,

(Name of Contractor)

as Principal, hereinafter called the Principal and

(Name of Surety)

a duly admitted insurer under the laws of the Territory of Guam, as Surety, hereinafter called the Surety, are held and firmly bound unto the Territory of Guam for the sum of _____ Dollars ($_____), for payment of which sum will and truly to be made, the said Principal and the said Surety bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a bid for

NOW THEREFORE, if the Territory of Guam shall accept the bid of the Principal and the Principal shall not withdraw said bid within sixty (60) calendar days after the opening of bids, and shall within fourteen (14) working days after the prescribed forms are presented to him for signature, enter into a Contract with the Territory of Guam in accordance with the terms of such bid and give such bond or bonds as may be specified in the bidding or Contract Documents with good and sufficient surety for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof, or in the event of the failure of the Principal to enter into such Contract and give such bond or bonds, if the Principal shall pay to the Territory of Guam the difference not to exceed the penalty hereof between the amounts specified in said bid and such larger amount for which the Territory of Guam may in good faith contract with another party to perform work covered by said bid or an appropriate liquidated amount as specified in the Invitation for Bids then this obligation shall be null and void, otherwise to remain in full force and effect.

Signed and sealed this _____ day of _____, _____.

_____

(PRINCIPAL) (SEAL)

(WITNESS)

(TITLE)

(MAJOR OFFICER OF SURETY)

(TITLE)

(MAJOR OFFICER OF SURETY)

(TITLE)

(RESIDENT GENERAL AGENT)

CONTRACT NO.

CONTRACT

(Contractor)

Guam Power Authority

Contract for:	Dededo Indoor Substation
Project No.:	GPA-E-100110
Amount:	$
Place:	Dededo

FORMAL CONTRACT

THIS AGREEMENT AND FORMAL CONTRACT, made and entered into this ____ day of _____, 20___, by and between the Government of Guam, hereinafter called the "Government", represented by the Contracting Officer executing this contract, party of the first part, and _____, a corporation, partnership or sole proprietorship of Guam, hereinafter called the "Contractor", party of the second part.

WITNESSETH, That whereas the Government intends to construct the Dededo Indoor Substation hereinafter called the "Project", in accordance with the drawings, specifications and other contract documents prepared by the Guam Power Authority,

NOW THEREFORE, the Government and Contractor for the considerations hereinafter set forth, agree as follows:

I. THE CONTRACTOR AGREES to furnish all the necessary labor, materials, equipment, tools and services necessary to perform and complete in a workmanlike manner all the work required for the construction of the Project, in strict compliance with the contract documents herein mentioned, which are hereby made a part of the contract, including the following addenda:

Addendum No. Dated

(a) Contract Time: The Contractor agrees to commence work under this contract upon written notice to proceed, and to complete the project ready for use and operation within five hundred fifty (550) calendar days of the commencement of the contract time as stated in the Instructions to Bidders of the contract.

(b) Subcontractors: The Contractor agrees to bind every subcontractor by the terms of the contract documents. The contract documents shall not be construed as creating any contractual relation between any subcontractor and the Government.

II. THE GOVERNMENT AGREES to pay, and the Contractor agrees to accept, in full payment for the performance of this contract, the contract amount of _____ *Dollars ($_____.00)* plus any and all sums to be added and/or deducted resulting from all extra and/or omitted work in connection therewith, as authorized under the terms as stated in the General Conditions of the contract, all in accordance with the terms as stated in the contract documents.

(a) Progress payments will be made as specified in the General Conditions.

III. CONTRACT DOCUMENTS: It is hereby mutually agreed that the following list of instruments, plans, specifications and documents which are attached hereto, bound herewith or incorporated herein by reference shall constitute the contract documents, all of which are made a part hereof, and collectively evidence and constitute the contract between the parties hereto, and they are as fully a part of this Agreement as if they were set out verbatim and in full herein, and are designated as follows:

a) Invitation to Bid
b) Instructions to Bidders
c) Bid Form
d) Bid Bond
e) Formal Contract
f) Performance and Payment Bonds
g) Special Provisions
h) General Conditions
i) General Scope of Work
j) Prevailing Wage Rates
k) Technical Specifications
l) Plans
m) Addendum(s)

IV. LIQUIDATED DAMAGES: The Contractor further agrees to pay to the Government the ***sum of $1,000.00*** per calendar day, not as a penalty, but as a reasonable liquidated damages for breach of this contract by the Contractor by his failing, neglecting or refusing to complete the work within the time herein

specified and said sums shall be paid for each consecutive calendar day thereafter that the Contractor shall be in default after the time stipulated in the contract for completing the work ready for use and/or operation.

V. COVENANT AGAINST CONTINGENT FEES. The Contractor warrants that he has not employed any person to solicit or secure this contract upon any agreement for a commission, percentage, brokerage or contingent fee. Breach of this warranty shall give the Government the right to terminate the contract, or in its discretion, to deduct from the contract price or consideration the amount of such commission, percentage, brokerage or contingent fee. The warranty shall not apply to commissions payable by contractors upon contracts or sales secured or made through bonafide established commercial or selling agencies maintained by the Contractor for the purpose of securing business.

VI. OTHER CONTRACTS. The Government may award other contracts for additional work, and the Contractor shall fully cooperate with such other contractors and carefully fit his own work to that provided under other contracts as may be directed by the Contracting Officer. The Contractor shall not commit or permit any act which will interfere with the performance of work by any other contractor.

VII. DISPUTES. Except as otherwise specifically provided in this contract, all disputes concerning questions of fact arising under this contract shall be decided by the Contracting Officer whose decision shall be final and conclusive upon the parties thereto. In the meantime the Contractor shall diligently proceed with the work as directed.

VIII. CONTRACT BINDING. It is agreed that this contract and all of the Covenants hereof shall inure to the benefit of and be binding upon the Government and the Contractor respectively and his partners, successors, assignees and legal representatives. Neither the Government nor the Contractor shall have the right to assign, transfer or sublet his interests or obligations hereunder without written consent of the other party. It is hereby mutually agreed by and between the parties hereto that no mechanic, contractor, subcontractor, material man or other person can or will contract for or in any other manner have or acquire any lien upon the binding or works covered by this contract, or the land upon which the same is situated.

IX. INDEMNITY. Contractor agrees to save and hold harmless the Government, its officers, agents, representatives, successors and assigns and other governmental agencies from any and all suits or actions of every nature and kind, which may be brought for or on account of any injury, death, or damage arising or growing out of the acts or omissions of the Contractor, Contractor's officers, agents, servants or employees under this contract.

IN WITNESS WHEREOF the parties hereto have executed this contract as of the day and year first written

CONTRACTOR

_____

Date: _____

GUAM POWER AUTHORITY

_____
JOAQUIN C. FLORES, P.E.
General Manager

Date: _____

APPROVED AS TO FORM:

_____

Date: _____

PERFORMANCE AND PAYMENT BONDS

KNOW ALL MEN BY THESE PRESENTS that

_____

(Name of Contractor)

Hereinafter called the Contractor and

_____

(Name of Surety)

a corporation duly organized under the laws of the State of _____ authorized to transact business in Guam, as Surety, are held and firmly bound unto the Guam Power Authority, as obligee, hereinafter called the Government for use and benefit of claimants as herein below defined, in the amount of _____ Dollars ($_____) for the payment whereof the Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Contractor has by written Agreement dated _____, entered into a Contract with the Guam Power Authority for the

_____

In accordance with Drawings and Specifications prepared by the Guam Power Authority, which Contract is by reference made a part hereof, and is hereinafter referred to as the Contract.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that, if the Contractor shall promptly and faithfully perform said Contract, and shall promptly make payment to all claimants as hereinafter defined for all labor and material used or reasonably required for use in the performance of the Contract, then this obligation shall be void; otherwise it shall remain in full force and effect, subject, however, to the following conditions:

A. The Surety hereby waives notice of any alteration or extension of the time made by the Guam Power Authority provided the same is within the scope of the Contract.

B. Whenever Contractor shall be and is declared in default by the Guam Power Authority to be in default under the Contract, the Guam Power Authority having performed obligations thereunder, the Surety may promptly remedy the default or shall promptly:

1. Complete the Contract in accordance with its terms and conditions; or

2. Obtain a bid or bids for completing the Contract in accordance with its terms and conditions, and upon determination by the Guam Power Authority and the Surety of the lowest responsive, responsible bidder, arrange for a Contract between such bidder and the Government, and make available as work progresses (even though there should be a default or a succession of defaults under the Contract or Contracts of completion arranged under this paragraph) sufficient funds to pay the cost of completion less than balance of the Contract price, but not exceeding, including other costs and damages for which the Surety may be liable hereunder, the amount set forth in the first paragraph hereof. The term "balance of the contract price" is the amount due from the Guam Power Authority to the Contractor under the Contract and any amendments thereto, less the amount properly paid by the Guam Power Authority to the Contractor. No right of action shall accrue on this bond to or for the use of any person or corporation other than the Guam Power Authority or successors of the Authority.

C. A claimant is defined as one having a direct contract with the Contractor or with a sub-contractor of the Contractor for labor, material, or both, used or reasonably required for use in the performance of the Contract, labor and material being construed to include that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental of equipment directly applicable to the Contract.

D. The above-named Contractor and Surety hereby jointly and severally agree with the Guam Power Authority that every claimant as herein defined, who has not been paid in full before the expiration of a period of ninety (90) calendar days after the date on which the last of such claimant's work or labor was done or performed, or materials were furnished by such claimant, may sue on this bond for use of such claimant, prosecute the suit to final judgment for such sum or sums as may be justly due claimant, and have execution thereon. The Guam Power Authority shall not be liable for the payment of any costs or expenses of any such suit.

E. No suit or action shall be commenced hereunder by any claimant:

1. Unless claimant, other than one having a direct contract with the Contractor, shall have given written notice to any two of the following:

   The Contractor, the Guam Power Authority, or the Surety above named, within ninety (90) calendar days after such claimant did or performed the last of the work or labor, or furnished the last of the materials for which said claim is made, stating with substantial accuracy the

amount claimed and the name of the party to whom the materials were furnished, or for whom the work or labor was done or performed. Such notice shall be personally served by mailing the same by registered mail or certified mail, postage prepaid, in an envelope addressed to the Contractor at any place the principal maintains an office or conducts its business.

2. After the expiration of one (1) year following the date on which the last of the labor was performed or material was supplied by the party bringing suit.

3. Other than in a court of competent jurisdiction in and for the Guam Power Authority.

F. The amount of the payment bond shall be reduced by and to the extent of any payment or payments made in good faith hereunder, inclusive of the payment by Surety of mechanics' liens which may be filed of record against said improvement, whether or not claim for the amount of such lien be presented under and against this bond.

SIGNED AND SEALED THIS _____ day of _____, 20___.

IN THE PRESENCE OF:

(Note: If the Principals are Partners, each must execute the Bond)

_____ _____

(WITNESS) (CONTRACTOR) (SEAL)

_____ _____

(TITLE)

_____ _____

(WITNESS) (MAJOR OFFICER OF SURETY)

_____ _____

(TITLE) (TITLE)

_____

(RESIDENT GENERAL AGENT)

SPECIAL PROVISIONS

1. General Intention. It is the declared intention and meaning to provide and secure the Dededo Indoor Substation, GPA Project No. E-100110.

2. Bid. The Contractor and each and every subcontractor shall read the General Conditions immediately following these special provisions, and by the act of submitting a bid, shall be deemed to have accepted all conditions contained therein.

3. Specifications and Standards. The specifications and standards referenced in this specification (including addenda, amendments and errata listed) shall govern in all cases where the references thereto are made. In case of a difference between the referenced specifications or standards and this specification or its accompanying drawings, this specification and its accompanying drawings shall govern to the extent of such difference, otherwise the referenced specifications and standards shall apply. Extra care shall be exercised to refer in requests for quotations in orders and in subcontracts to the referenced specifications and to all modifications thereof.

4. Time for Completion. It is hereby understood and mutually agreed, by and between the Contractor and the Government of Guam, that the date of beginning, rate of progress and the time for completion of the work to be done hereunder are essential conditions of this contract; and it is further mutually understood and agreed that the work embraced in this contract shall be commenced on a date to be specified in the Notice to Proceed and shall be completed within five hundred fifty (550) calendar days after the specified date in the Notice to Proceed.

5. Liquidated Damages. It is hereby understood and mutually agreed, by and between the Contractor and the Guam Power Authority, that liquidated damages shall be assessed for each calendar day the work remains incomplete.

   If the said Contractor shall neglect, fail or refuse to complete the work within the time herein specified, the Contractor does hereby agree, as a part consideration for the awarding of this contract, to pay to the Guam Power Authority the *amount of $1,000.00* per calendar day, not as a penalty but as liquidated damages for such breach of contract as hereinafter set forth, for each and every calendar day that the Contractor shall be in default of the time stipulated in the contract for completing the work.

   The said amount is fixed and agreed upon by and between the Contractor and the Guam Power Authority because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages the Guam Power Authority would in such event sustain, and said amounts shall be retained from time to time by the Guam Power Authority from current periodical estimates.

   It is further agreed that time is of the essence of each and every portion of this contract and of the specifications wherein a definite and certain length of time is fixed for the performance of any act whatsoever; and where under the contract an additional time is allowed for the completion of any work, the new time limit fixed by such extension shall be of the essence of this contract. Provided, that the

Contractor shall not be charged with liquidated damages of any excess cost when the delay in completion of the work is due

a. to any preference, priority or allocation order duly issued by the Guam Power Authority.

b. to unforeseeable causes beyond the control and without the fault or negligence of the Contractor, including but not restricted to acts of God or the public enemy, acts of the Guam Power Authority, acts of another Contractor in the performance of a contract with the Guam Power Authority, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and unusually severe weather; and

c. to any delays of Subcontractors or suppliers occasioned by any of the causes specified in subsections (a) and (b) of this article.

Provided further that the Contractor shall, within seven (7) calendar days from the beginning of delay, notify the Contracting Officer in writing of the causes of the delay who will ascertain the facts and extent of the delay and notify the Contractor within reasonable time of his decision in the matter.

The Contractor must note that Guam by nature has frequent rainfall causing suspension of work. Said suspensions shall not qualify for time extensions unless the weather is unusually severe.

6. Environmental Protection Requirements

a. Provide and maintain during the life of the contract, an environmental protection plan. Provide environmental protective measures, as required to control pollution that develops during normal construction practice.

b. Provide also environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the project. Comply with all federal and local statutes and regulations pertaining to environmental protection.

In particular, comply with the requirements of and promulgated regulations resulting from Title X, Chapters 45 through 52 of the Government Code of Guam. DEFINITIONS OF CONTAMINANTS.

c. Solid waste Disposal Permit: Submit one copy of local permit or license which reflects Guam Environmental Protection Agency approval of the disposal plan as being in compliance with their solid waste disposal regulations.

7. Disposal. Unsuitable materials as a result of contractor's operations shall be disposed of in accordance with the local laws and/or policies of concerned agencies. Disposal, tipping fees/charges shall be at the contractor's expense.

8. The Contractor shall investigate the project site prior to bidding and verify existing conditions and dimensions. Failure to do so shall not be cause for additional claims against the Authority. Any work related to conditions not reflected on the plans will be performed at the Contractors expense.

9. The Contractor shall submit technical brochures samples, shop drawings and details as required by the Project Engineer prior to purchase or installation.

10. Material Standards: All materials and equipment must conform to applicable standards of organizations such as the American Standard Institute (ANSI), the American Society for Testing and Materials (ASTM), the National Electrical Manufacturers Association (NEMA), and the Underwriters Laboratories (UL). Proof of such conformance shall be submitted to the Project Engineer for approval. References to various standards contained in the specification and drawings shall be understood to be the issue or revision in effect on the date of the bid submittal. Any deviation shall be detailed in a written request to GPA Engineering for approval and shall not be initiated until written approval is received by the Contractor from GPA.

11. Contractor-Furnished Equipment: All materials and equipment, except for those specifically identified, required to complete the project shall be furnished by the Contractor.

12. Owner-Furnished Equipment:

    a. GPA reserves the option to supply the materials and not award the materials in whole or in part. Should GPA exercise this option, all other materials necessary for the installation and completion of the project, shall be furnished by the Contractor.

    b. GPA will adjust the total lump sum bid before award. The cost deducted will be the values provided by the bidder.

    c. The Contractor shall be responsible to transport owner-furnished equipment from the Owner's designated storage site to the job site.

        1) The Contractor shall repair or replace these items if damaged during transport to the site. In addition, the Contractor shall repair any damage to public and private property caused by the transport of these items.

        2) All materials and equipment to be furnished by GPA are in good condition. Prior to the start of construction, the Contractor shall inspect these items and acknowledge the receipt thereof. The Contractor is responsible for repairing and replacing any damage or theft of equipment or damage which causes the equipment to be inoperable from the date it was received and prior to final acceptance of this project. All expenses shall be the Contractor's responsibility. Replacement materials and equipment shall be of a type and quality equal to the original materials and equipment, shall be acceptable to the Owner, and shall be obtained expeditiously to

prevent delay of the work. Extensions of time will not be granted for delays caused by failure to receive replacement materials and equipment at the time required for their installation.

3) The Contractor shall be responsible for the prompt unloading of all equipment and materials received into his custody and shall pay any demurrage. If any Owner-furnished materials and equipment arrive after working hours, the Contractor shall assign personnel to receive and inspect all such shipments and shall pay all base time and overtime costs for such work.

4) The Contractor shall maintain a current, accurate inventory and record of location for all equipment and materials in his custody.

13. Underground Utilities Clearance:

a. The Contractor shall secure all permits required for construction including permits by the Department of Public Works, U.S. Navy, State Historic Preservation Office, GWA, GTA, GPA, Department of Parks and Recreation, MCV, and other agencies involved.

b. The Contractor shall coordinate with the government and private utility agencies in obtaining underground clearance prior to excavation. Extra care shall be taken so as not to damage any existing underground utilities. Any damaged utilities and any effects of the damage shall be the Contractor's responsibility. The Contractor shall be responsible for all charges related to securing underground utilities.

14. Power Shutdown of Existing Circuits:

a. Due to the critical nature of and the significance to the customers served by the 13.8 kV circuits in the project area, close and careful coordination of the outage requirements is a must. For all scheduled outages required by the contract, the Contractor must:

1) Submit a written request to the Chief Dispatcher, GPA PSCC Department two weeks (14 days) prior to the outage date. No outage will be granted without a written request.

2) Coordinate closely with Superintendent of Overhead Lines, GPA T&D Department or his designated representative.

3) Outages are limited to a maximum of six (6) hours daily. GPA Customers shall not experience a scheduled interruption exceeding six (6) hours per day. Scheduled interruptions affecting the same customers on consecutive days are not permitted. The Contractor shall give consideration to prevent such occurrences.

4) The Contractor shall provide an outage plan on areas affecting schools for GPA's

approval prior to start of work. The following shall be incorporated in the outage plan in addition to the requirements indicated above.

a) No outages shall be permitted during school hours.

b) The outage plan shall be practical and incorporated in the project schedule to meet the required completion.

c) GPA will not consider any requests for time extension due to outages restrictions caused by school schedules.

5) GPA will be responsible for notifying the media and public announcements. GPA will also be responsible for de-energizing and re-energizing circuits as required by the project.

15. Surplus Materials: Existing materials removed shall be cleaned, disassembled and assumed in good condition before returning the materials to the Dededo Warehouse or Dededo Pole Yard. Hardware, wire, insulators, crossarms, poles, etc. shall be returned and signed by item lots to GPA. The Contractor shall coordinate two working days in advance with the GPA Project Engineer prior to scheduling the return of materials. Materials returned shall be signed for and the credit receipt shall be acknowledged by the GPA Project Engineer or GPA Project Inspector. The Contractor shall be responsible for proper accounting of all returned materials. Any difference between the credit receipts and removal quantities, as determined by the GPA Project Engineer, shall be the Contractor's financial responsibility. The difference shall be deducted from the total value of the Contract at the end of the project. Unsalvageable, rotten or junk materials, must be certified by the GPA Project Engineer or GPA Inspector in writing, and shall be properly disposed of, at the Layon landfill or an approved disposal location.

16. Handling and Storage: The Contractor shall promptly receive, unload, and place into storage all equipment, materials, and supplies arriving at the project site for the work under this Contract. This shall include equipment and materials furnished by the Owner and specified to be erected and installed under this Contract. The Contractor shall provide all required storage facilities.

a. Hazardous Materials

1) All shipments of Contractor-furnished equipment or materials arriving at the site containing hazardous materials shall be identified on the materials list. A copy of all hazardous materials documentation required shall be included with the materials list and shall also be included with the shipping papers attached to the shipment.

2) No hazardous materials shall be disposed of at the site. Any hazardous materials which the Contractor must dispose of shall be removed from the site by the Contractor and taken to an approved disposal facility in accordance with local, state,

and federal codes and regulations, all at the Contractor's expense. The Contractor shall notify the Owner of any disposal of hazardous materials.

3) Hazardous materials documentation provided by suppliers of Owner-furnished equipment and materials will be furnished to the Contractor.

b. Stored equipment and materials shall be adequately supported and protected to prevent damage. Equipment shall be moved into the permanent building or onto its permanent foundation as soon as construction will permit.

1) Stored materials and equipment shall not be allowed to contact the ground. In warehouses that do not have dry concrete or suspended floors, materials and equipment shall be stored on platforms or shoring.

2) Strip heaters and similar heating devices furnished with electrical equipment shall be electrically connected to provide protection during storage. Heaters shall be energized immediately upon placement of the equipment in storage, and maintained in an energized condition until they can be energized from a permanent electrical connection. If permanent electrical power is not available when the equipment is installed in its permanent location, electrical equipment requiring strip heaters and similar heating devices shall be suitably connected to a reliable temporary power source.

3) All openings in equipment and piping not stored under weatherproof covers shall be closed to prevent entrance of dirt or moisture during storage.

GENERAL CONDITIONS

I. DEFINITIONS

1. Owner

The term "Owner" as used herein means the Guam Power Authority (hereinafter called “GPA”) and shall include the Governor of Guam, and/or his authorized representatives.

2. Contracting Officer

The term "Contracting Officer" as used herein means the General Manager of the Guam Power Authority and shall include his authorized representatives.

3. Contractor

The term "Contractor" as used herein means the party or parties who or which shall have duly entered into a contract with the Government of Guam to perform the work herein contemplated or his or their authorized assignee.

4. Notice

The term "Notice" as used herein shall mean and include all written notice demands, instructions, claims, approvals and disapprovals required to obtain compliance with contract requirements. Any written notice by either party to the contract shall be sufficiently given if delivered to or at the last know business address of the person, firm, or corporation constituting the other party to the contract, or to his, their, or its duly authorized agent, representative, or officers, or when enclosed in a postage prepaid envelop addressed to such last known business address and deposited in a United States mail box. The Contractor must provide and maintain a post office address within Guam and file the same with the Contracting Officer.

5. Forms Enclosed

The copies of the form of agreement and form of bid bond, enclosed herewith are incorporated in these General Conditions by reference and are made a part hereof to the same extent as though fully set forth herein.

II. CONSTRUCTION CONTRACT

1. Contract Documents

a) The contract documents consist of the Agreement, and technical specifications, including all addenda and alterations made in the documents prior to their execution.

b) The contract documents shall be signed by the Owner and Contractor.

c) Anything called for by one of the contract documents and not called for by the others shall be of like effect as if required or called for by all. In case of discrepancies between the contract documents, the agreement shall take precedence over the technical specifications. Any discrepancies between the contract documents shall be called to the attention of the Contracting Officer before proceeding with work affected thereby.

d) It will be conclusively presumed that the Contractor has read, examined and agreed to each and every term, conditions, provisions, covenant or agreement in the technical specifications, bid forms, contract, and conditions related to the work to be carried on, said documents being on file in the Procurement Office, Guam Power Authority, Harmon, Guam.

2. Drawings

a) The general character and scope of the work are illustrated by the drawings. Any additional detail drawings and other information deemed necessary by the Contracting Officer will be furnished to the Contractor when and as required.

b) In case of differences between small scale and large scale drawings, the large-scale drawings shall govern. Figured dimensions on the drawings shall be considered primary compared with measurements obtained through scaling of drawings. The Contractor shall verify all dimensions, and if any be lacking, he shall call the attention thereto and be governed by the decision of the Contracting Officer.

c) Where on any of the drawings a portion of the work is drawn out and the remainder is indicated in outline, the parts drawn out shall apply also to all other like portions of the work.

d) Where the word "similar" occurs on the drawings, it shall be interpreted in its general sense and not as meaning identical.

e) The approval of shop and setting drawings will be general and, except as otherwise provided in paragraph, shall not be construed (1) as permitting any departure from the contract requirements, (2) as relieving the Contractor of the responsibility for any

error in details, dimensions and otherwise that may exist; (3) as approving departures from additional details or instructions previously furnished by the Contracting Officer.

3. Detail Drawings and Instructions

a) The Contractor will be furnished additional instructions and detail drawings as may be necessary to carry out the work included in the contract. The additional drawings and instructions thus supplied to the Contractor shall be consistent with the contract documents and true developments thereof, and shall be so prepared that they can be reasonably interpreted as a part thereof. The Contractor shall carry out the work in accordance with the additional detail drawings and instructions.

b) The Contracting Officer, at any time, by written order designated or indicated to be a change order, make any change in the work within the general scope of the contract, including but not limited to changes:

(1) In the specifications (including drawings and designs);
(2) In the method or manner of performance of the work;
(3) In the Government-furnished facilities, equipment, materials, services for site; or
(4) Directing acceleration in the performance of the work.

c) Any other written order or an oral order (which terms as used in paragraph (b) shall include direction, instructions, interpretations or determination from the Contracting Officer) which causes any such change, shall be treated as a change order under this clause, provided that the Contractor gives the Contracting Officer written notice stating the date, circumstances and source of the order and that the Contractor regards the order as a change order.

d) Except as herein provided, no order, statement, or conduct of the Contracting Officer shall be treated as a change order under this clause or entitle the Contractor to an equitable adjustment hereunder.

4. Shop Drawings

a) The Contractor shall submit for the approval of the Contracting Officer, shop and setting drawings and schedules required by the specifications or that may be requested by the Contracting Officer and no work shall be fabricated by the Contractor, save at his own risk, until such approval has been given.

b) Drawings and schedules shall be submitted in quadruplicate (unless otherwise specified) accompanied by letter of transmittal which shall give a list of the numbers and dates of the drawings submitted. Drawings shall be complete in every respect and bound insets. Shop drawings shall be presented in a clear and thorough manner.

Prepare shop drawings using AutoCAD 2005 format or latest version.

c) The Contractor shall submit all drawings and schedules sufficiently in advance of construction requirements to allow ample time for checking, correcting, resubmitting and rechecking.

d) The drawings submitted shall be marked with the name of the project, numbered consecutively and bear the stamp of approval of the Contractor as evidence that the drawings have been checked by the Contractor. Any drawings submitted without this stamp of approval will not be considered and will be returned to the Contractor for re-submission. If the shop drawings show variations from the requirements of the contract because of standard shop practice or other reasons, the Contractor shall make specific mention of such variation in his letter of transmittal so that if any variations are acceptable, suitable action may be taken for proper adjustment; otherwise, the Contractor will not be relieved of the responsibility for executing the work in accordance with the contract even though such shop drawings have been approved.

e) If a drawing as submitted indicates a departure from the contract requirements which the Contracting Officer finds to be in the interest of the Owner and to be so minor as not to involve a change in the contract price or time for performance, he may approve the drawing.

5. Specifications and Drawings

a) The Contractor shall keep on the work site a copy of the drawings and specifications including all authorized change orders, and shall at all times give the Owner, Contracting Officer and their representatives access thereto.

b) All drawings and specifications and copies thereof furnished by the Contracting Officer are his property and shall not be used on other projects without his consent. Upon completion of this project all copies of the drawings and specifications except the signed contract sets are to be returned to the Contracting Officer upon his request.

6. Special Requirements

a) Where special requirements, provisions or specifications or detailed specifications are attached hereto or are included in the proposal they shall be considered a part of these general conditions or specifications or detailed specifications as fully as if contained herein. Should any special provisions be in conflict with these general conditions or specifications or detailed specifications, said special requirements, provisions or detailed specifications shall govern.

b) Person in charge of electrical wiring and installations shall be a licensed Master Electrician and/or Registered Electrical Engineer in Guam.

7. Explanation to Bidders

Discrepancies, omissions, or doubts as to the meaning of bid submittal documents, contract provisions and technical specifications should be communicated in writing to the Contracting Officer for interpretation. Bidders should act promptly and allow sufficient time for a reply to reach them. Every interpretation made to a bidder will be in the form of an addendum to the Invitation for Bids documents which, if issued, will be sent as promptly as practicable to all persons to whom the bid documents have been issued. All such addenda shall become part of the contract documents.

III. BIDS, BIDDER RESPONSIBILITIES

1. Conditions at Site or Building

a) Bidders should visit the site and shall be responsible for having ascertained pertinent conditions such as location, accessibility, and general character of the site or building, the character and extent of existing work within or adjacent to the site, and any other work being performed thereon at the time of the submission of his bid. No extra compensation will be made by reason of any misunderstanding or error as regards to the site, the conditions thereof, accessibility or the amount of kind of work to be performed.

b) If, in the performance of the contract, subsurface or latent conditions at the site are found to be materially different from those indicated by the drawings and specifications, or unknown conditions of an unusual nature are disclosed differing materially from the conditions usually inherent in work of the character shown and specified, the attention of the Contracting Officer shall be called immediately to such conditions before they are disturbed. Upon such notice, or upon his own observation of such conditions, the Contracting Officer shall promptly make such changes in the drawings and specifications as he finds necessary to conform to the different conditions, and any increase or decrease in the cost of the work resulting from such changes shall be adjusted as provided under Changes in Work.

2. Submission of Bids

a) The bidder is required to bid on all items called for in the Bid Form.

b) Bids shall be submitted on the forms furnished or copies thereof, and shall be signed in ink. Erasures or other changes in a bid must be explained or noted over the signature of the bidder. Bids containing any conditions, omissions, unexplained

erasures or alterations or items not called for in the proposal or irregularities of any kind may be rejected by the Owner as being incomplete.

c) Each bid must give the full business address of the bidder and be signed by him with his usual signature. Bids by partnerships must furnish the full names of all partners and must be signed in the name of the partnership by one of the members of the partnership or by an authorized representative followed by the signature and designation of the person signing. Bids by corporations must be signed with the legal name of the corporation, followed by the name of the State of incorporation and by the signature and designation of the president, secretary, or other person authorized to bind it in the matter. The name of each person signing shall also be typed or printed below the signature. A bid by a person who affixes to his signature the word "president", (agent or other designation, without disclosing his principal), may be held to the bid of the individual signing. When requested by the Owner, satisfactory evidence of the authority of the officer signing in behalf of the corporation shall be furnished.

3. Bid Guarantee

Bids shall be accompanied by a bid guarantee of not less than fifteen percent (15%) of the total bid amount for which an award can be made. Bid guarantee may be bid bond (form enclosed), certified check or cashier's check. Bid bond shall be signed by the bidder, two major officers of the Surety and Resident General Agent, if the Surety is a foreign or alien surety and shall be accompanied with copies of current Certificate of Authority to do business on Guam issued by the Department of Revenue and Taxation, Power of Attorney issued by the Surety to the Resident General Agent and Power of Attorney issued by two major officers of the Surety to whoever is signing on their behalf. Certified check or cashier's check must be issued by a banking institution licensed to do business on Guam and shall be made payable to the Guam Power Authority. Such bid bond or check shall be submitted with the understanding that it shall guarantee that the bidder will not withdraw his bid for a period of sixty (60) calendar days after the scheduled closing time for the receipt of bids; that if his bid is accepted, he will enter into a formal contract with the Owner in accordance with the form of agreement included as a part of the contract documents, and that the required performance and payment bond will be given; and that in the event of the withdrawal of said bid within said period, or the failure to enter into said contract and give said bond within ten (10) working days after he has received notice of the acceptance of his bid, the bidder shall be liable to the Owner for the full amount of the bid guarantee as representing the damage to the Owner on account of the default of the bidder in any particular hereof. The bid guarantee shall be returned to all except the three lowest bidders within three days after the formal opening of bids. The bid guarantee of the second and/or third low bidder shall be returned thirty (30) calendar days after the bid opening date upon request, provided that he has not been notified by the Owner of the acceptance of his bid prior to the date of such request. The bid guarantee of the lowest qualified bidder shall be returned within forty eight (48) hours after the Owner and the qualified bidder have executed the contract.

4. Withdrawal of Bids

Bids may be withdrawn on written or telegraphic request received from bidders prior to the time fixed for opening. Negligence on the part of the bidder in preparing the bid confers no right to the withdrawal of the bid after it has been opened.

5. Publicity of Bids

At the time fixed for the opening of bids, the contents of the bids will be made public for the information of bidders and others properly interested who may be present either in person or by representation.

6. Receipt and Opening of Bids

a) Bids will be opened publicly at the time and place stated in the invitation for bids. The officer whose duty it is to open them will decide when the specified time has arrived and bids received thereafter will not be considered. No responsibility will be attached to any officer for the premature opening of a bid not properly addressed and identified.

b) Telegraphic bids will not be considered, but modifications by telegraph of bids already submitted will be considered if received prior to time set for opening.

7. Rejection of Bids

The Owner reserves the right to reject any and all bids when such rejection is in the interest of the Owner and to reject the bid of a bidder who is not in a position to perform the contract.

8. Award of Contract

a) The contract will be awarded as soon as possible to the lowest responsive and responsible bidder, provided it is in the interest of the Owner to accept his bid.

b) The Owner reserves the right to waive any informality in bids received when such waiver is in the interest of the Owner. The Owner also reserves the right to accept any item in the bid and to reject any item in the bid unless otherwise specified by the Owner.

9. Performance and Payment Bond

The successful bidder must deliver to the Owner an executed performance and payment bond (forms enclosed) in an amount at least equal to one hundred percent (100%) of the accepted bid as security for the faithful performance of the contract and security for the payment of all

persons performing labor and furnishing materials in connection with this contract. The sureties of all bonds shall be such surety company or companies as are approved by the Owner and as are authorized to transact business in Guam. The bonds must be approved by the Owner prior to execution of the formal contract.

10. Cancellation of Award

The Owner reserves the right to cancel the award of any contract at any time before the execution of same.

IV. DUTIES OF CONTRACTING OFFICER AND CONTRACTOR SAFETY MEASURES

1. Authority of Contracting Officer

The Contracting Officer shall give all orders and directions contemplated under this contract and specifications relative to the execution of the work. The Contracting Officer shall determine the amount, quality, acceptability, and fitness of the several kinds of work and materials which are to be paid or under this contract and shall decide all questions which may arise in relation to paid work and the construction thereof. The Contracting Officer's estimates and decisions shall be final and conclusive, except as herein otherwise expressly provided. In case any question shall arise between the parties hereto relative to said contract or specifications, the determination or decision of the Contracting Officer shall be a condition precedent to the right of the Contractor to receive any money or payment for work under this contract affected in any manner or to any extent by such question.

The Contracting Officer shall decide the meaning and intent of any portion of the specifications and of any plans or drawings where the same may be found obscure or be in dispute.

Any difference or conflicts in regard to their work which may arise between the Contractor under this contract and other Contractors performing work for the Owner shall be adjusted and determined by the Contracting Officer.

2. Contractor's Obligations

The Contractor shall, in good workmanlike manner, do and perform all work and furnish all supplies and materials, machinery, equipment, facilities and means, except as herein otherwise expressly specified, necessary or proper to perform and complete all the work required by this contract within the time herein specified in accordance with the plans and drawings of the work covered by this contract and any and all supplemental plans and drawings, and in accordance with the directions of the Contracting Officer as given from time to time during the progress of the work. He alone shall be responsible for the safety, efficiency and adequacy of his plant, appliances and methods, and for any damage which

may result from their failure or their improper construction, maintenance or operations. The Contractor shall observe, comply with and be subject to all terms, conditions, requirements, and limitations of the contract and specifications and shall do carry on and complete the entire work to the satisfaction of the Contracting Officer and the Owner.

3. Superintendence by Contractor

The Contractor shall give his personal superintendence to the work or have a competent foreman or superintendent, satisfactory to the Contracting Officer, on the work at all times during progress with authority to act for him.

4. Subcontracts

a) Nothing contained in the specifications or drawings shall be construed as creating any contractual relationship between any subcontractor and the Owner. The diffusion or sections of the specifications are not intended to control the Contractor in dividing the work among subcontractors or to limit the work performed by any trade. The Contractor shall be as fully responsible to the Owner for the acts and omissions of subcontractors and of persons employed by them, as he is for the acts and omissions of persons directly employed by him.

b) The Contractor shall be responsible for the coordination of the trades, subcontractors, and material men engaged in his work.

c) The Contractor shall, without additional expense to the Owner, utilize the services of specialty subcontractors on those parts of the work which are specified to be performed by specialty subcontractors.

d) The Owner will not undertake to settle any differences between the Contractor and his subcontractors or between subcontractors.

e) The Contractor shall cause appropriate provisions to be inserted in all subcontracts relative to the work including waiver of mechanics liens to bind subcontractors by the terms of the General Conditions and other contract documents insofar as applicable to the work of subcontractors and to give the Owner any exercise over the Contractor under any provisions of the contract documents.

5. Subletting

Subletting part of the work is permitted. However, bidder must note that subletting in excess of the following is not allowed:

a) Where the subletting is for both labor and material, total cost of sublet work shall not exceed 49% of the contract amount.

b) Where subletting is for labor only, sublet work cost shall not exceed 20% of the total contract amount. Information concerning subcontracts must form a part of the bid documents and shall be submitted on standard "Subcontract" information form.

6. Assignments

The Contractor shall not assign the whole or any part of this contract or any monies due or to become due hereunder without the written consent of the Owner and of all the sureties executing any bonds on behalf of the Contractor in connection with said contract. In case the Contractor assigns the whole or any part of said contract or assigns all or any part of any monies due or to become due under said contract, the instrument of assignment shall contain a clause substantially to the effect that it is agreed that the right of the assignee in and to any monies due or to become due the Contractor or otherwise shall be subject to all of the terms and conditions of said contract or supplemental thereto, the rights and remedies of the Owner thereunder or arising by operation of the law and to the liens of all persons, firms, and corporations for services rendered or materials supplied in connection with the performance of said contract.

7. Equal Opportunity

a) The Contractor will not discriminate against any employee or applicant for employment because of race, religion, sex, color, age, economic status, or national origin. The Contractor will take affirmative action to insure that qualified applicants are employed and that employees are treated during employment without regard to their race, religion, sex, color, age, economic status, or national origin. Such action shall include, but not be limited to, the following: Employment, upgrading, demotion or transfer, recruitment or recruitment advertising, layoffs or termination, rates of pay or other forms of compensation, and selection for training including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the Contracting Officer setting forth the provisions of this nondiscrimination clause.

b) The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor; state that all qualified applicants will receive consideration for employment without regard to race, religion, sex, color, age, economic status, or national origin.

c) The Contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the Contracting Officer, advising the said labor union or workers' representative of the Contractor's commitments under Section 202 of Executive Order No. 11246 of September 24, 1965 and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

8. Hiring of Apprentices

The Contractor shall hire for performance of work under this contract apprentice(s) to be employed in the performance of work under this contract in accordance with Executive Order No. 2000-10 dated April 11, 2000 (See Attachment "A" to General Conditions).

9. Minimum Wage Rate

All persons employed on this project shall be paid not less than minimum wage applicable to the corresponding skill or craft as determined by the Department of Labor, Government of Guam. Prevailing wage rates of Department of Labor, Government of Guam are attached herewith and shall be deemed a part of the contract documents.

10. Laws, Permits and Regulations

a) Building permit for the project shall be secured and paid for by the Contractor.

b) The Contractor shall pay all fees and charges for connection to outside service and use of property other than the site of the work for storage of materials or other purposes.

c) The Contractor shall comply with all laws, ordinances, regulations and building code requirements applicable to work hereunder unless in conflict with contract requirements. If the Contractor ascertains at any time that any requirement of this contract is a variance with applicable laws, ordinances, regulations, or building code requirements, he shall promptly notify the Contracting Officer and any necessary adjustment of the contract shall be made as specified under Changes in Work.

11. Contractor's and Subcontractor's Insurance

a) The contractor shall not commence work under this contract until he has obtained all the insurance required and such insurance has been approved by the Owner. The Contractor shall not allow any subcontractor to commence work on his subcontract until all similar insurance required of the subcontractor has been so obtained and approved. Approval of the insurance by the Owner shall not relieve or decrease the liability of the Contractor hereunder.

b) Workmen's Compensation and Employers Liability insurance – The limit of Workmen's Compensation shall be statutory and the Employers Liability limits shall be $500,000/$500,000/$500,000. This coverage shall cover all employees engaged in the work on the project under this contract and in case such work is sublet, the Contractor shall require the subcontractor similarly to provide Workman's

Compensation and Employers Liability insurance for all of the latter's employees to be engaged in such work. Add Waiver of Subrogation in favor of Owner.

c) Commercial General Liability Insurance including products, completed operations and contractual coverage for this Agreement in the amount of $1,000,000. Grant Waiver of Subrogation in favor of Owner. Owner is to be an additional insured.

d) Commercial Auto Liability Insurance covering bodily injury and property damage in the amount of $1,000,000 combined single limit. Grant Waiver of Subrogation in favor of Owner. Owner is to be an additional insured.

e) Excess Liability insurance with limits of $5,000,000 or higher. Owner is to be an additional insured.

f) Builders' Risk insurance is to be furnished by Contractor which shall include owner as a named insured. The limit of insurance shall be equal to the total limit of the project. The Contractor shall be responsible for the deductible regarding any loss.

g) Contractor shall furnish certificates of insurance and waiver of subrogation endorsement to owner prior to commencement of work showing evidence of such coverage, including the statement to the effect that cancellation or termination of the insurance shall not be effective until at least ten (10) days after receipt of written notice to owner. At all times Contractor's insurance shall be primary to any other insurance that may be carried by Owner. The statement of limits of insurance coverage shall not be construed as in any way limiting the Contractor's liability under this agreement. Owner shall be an additional insured on all liability coverage and certificates of insurance shall clearly indicate such.

h) Indemnity: The Contractor shall indemnify, defend and hold harmless owner against all loss, damage, or expense (including reasonable attorney's fees incurred by owner) arising out of the performance of the work, including injury or death to any person or persons resulting from the acts or omission of the Contractor or the Contractor's employees, servants, agents or subcontractors and from mechanics and materialmans liens.

12. Supplemental to Contractor's and Subcontractor's Insurance (Not Applicable)

Flood Hazard Insurance - The Contractor during the life of this contract shall secure and maintain Flood Hazard Insurance in the amount equivalent to 100 percent (100%) of the contract amount for all damages. The policies shall be in the name of the Owner and the Contractor.

A certificate of the insurance company as to amount and type of coverage, terms of policies, etc., shall be delivered to the Owner before commencing work.

13. Accident Prevention

a) Precaution shall be exercised at all times for the protection of persons (including employees) and property. The safety provisions of applicable laws, building and construction codes shall be observed. Machinery equipment and all hazards shall be observed. Machinery equipment and all hazards shall be guarded or eliminated in accordance with the safety provisions of the latest edition of the Manual of Accident Prevention in Construction published by the Associated General Contractors of America to the extent that such provisions are not in contravention of applicable laws.

b) Should typhoon warnings be issued, the Contractor shall take every practicable precaution to minimize damage and/or danger to persons, to the work, and to the adjacent property. These precautions shall include closing all openings, removing all loose materials, tools and/or equipment from exposed locations, and removing or securing scaffolding and all other temporary work.

14. Protection of Work and Property

The Contractor shall at all times safely guard the Owner's property from injury or loss in connection with this contract. He shall at all times safely guard and protect his own work and that of adjacent property (as provided by law and the contract documents) from damage. All passageways, guard fences, lights and other facilities required for protection by laws and regulations and local conditions must be provided and maintained.

15. Responsibility of Contractor to Act in Emergency

In case of an emergency which threatens loss of injury or property and/or safety of life, the Contractor shall act, without previous instructions from the Owner or Contracting Officer, as the situation may warrant. He shall notify the Contracting Officer thereof immediately thereafter of any compensation claimed by the Contractor. Substantiating documents regarding expenses shall be submitted to the Owner through the Contracting Officer and the amount of compensation shall be determined by agreement or arbitration.

16. Mutual Responsibility of Contractors

If the Contractor or any of his subcontractors or employees cause loss or damage to any separate contractor on the work, the Contractor agrees to settle with such separate contractor by agreement, if he will so settle. If such separate contractor sues the Owner on account of any loss so sustained, the Owner shall notify the Contractor who shall indemnify and save harmless the Owner against any expenses or judgment arising therefrom.

17. Use of Premises and Removal of Debris

The Contractor expressly agrees to undertake at his own expense

a) to take every precaution against injuries to persons or damages to property;

b) to comply with the regulations governing the operation of premises which are occupied and to perform his contract in such a manner as not to interrupt or interfere with the operation of other facilities;

c) to perform any work necessary to be performed after regular working hours or on Sundays or legal holidays without additional expense to the Owner;

d) to store his apparatus, materials, supplies, and equipment in such orderly fashion at the site of the work as will not unduly interfere with the progress of his work or the work of any other contractors;

e) to place upon the work or any part thereof only such loads as are consistent with the safety of that portion of the work;

f) to frequently clean up all refuse, rubbish, scrap materials and debris caused by his operation so that at all times the site of the work shall present a neat, orderly and workmanlike appearance;

g) to effect all cutting, fitting, or patching of his work required to make the same conform to the plans and specifications, and except with the consent of the Contracting Officer, not to cut or otherwise alter the work of any contractor;

h) before final payment to remove all surplus materials, false work, temporary structures, including foundations thereof, plant of any description and debris of every nature resulting from his operations, to put the site in a neat, orderly condition and to thoroughly clean and leave reasonably dust free all furnished surfaces.

18. Obstructions

The Contractor shall at his own expense remove all obstructions, the removal of which shall be necessary for the proper reception, performance, construction, installation and completion of all work under this contract.

19. Site of Contractor's Operations

The Contractor shall confine all construction operations within the vicinity of the site and shall arrange his work so that all construction materials and equipment are placed in such manner and location that there may be a minimum of interference or inconvenience inflicted upon the public and employees of the Government.

20. Barricades

The Contractor shall erect, install and maintain all temporary public walks, warning signs, barricades or other protective means in and around the site as deemed necessary or as may be ordered by the Contracting Officer for the effective protection of the public from injury and shall be held strictly liable for their safety.

21. Electrical Energy

The Contractor shall make all necessary applications, pay all fees and charges, obtain necessary permits and provide and maintain his own electrical power and light as required and necessary in the progress of any branch of the work. He shall provide all temporary wiring necessary.

22. Water

The Contractor shall make all necessary applications, pay all fees and charges, and obtain necessary permits for construction of temporary water required for use on this project. The nearest available source of water tap shall be verified by the Contractor. The Contractor shall be responsible for all expenses required for conveying water to the site from the available nearest source.

23. Signs

The Contractor shall erect a sign at the project site at his own expense. The location of sign shall be as directed by the Contracting Officer. Size of signs, lettering, and other pertinent data that should appear on the sign will be furnished by the Contracting Officer to the Contractor.

V. QUALITY OF WORK

1. Engineering and Layout

a) The Contractor shall provide competent engineering services to execute the work in accordance with the contract requirements. He shall verify the figures shown on the survey and approach drawings before undertaking any construction work and shall be responsible for the accuracy of the finished work.

b) The Owner has established or will establish such general reference points as will, in his judgment, enable the Contractor to proceed with the work. If the Contractor finds that any previously established reference points have been destroyed or displaced, he shall promptly notify the Owner.

c) The Contractor shall protect and preserve the established bench marks and monuments and shall make no changes in location without the written approval of the Owner. Any of them which may be lost or destroyed or which require shifting because of necessary changes in grades or locations shall be subject to prior approval by the Owner, be replaced and accurately located by the Contractor.

2. Shop Drawings, Materials and Workmanship

Unless otherwise specified, all materials and equipment incorporated in the work under the contract shall be new. All workmanship shall be first class and by persons qualified in the respective trades.

a) The Contractor shall submit, for the approval of the Contracting Officer, shop and setting drawings and schedules required by the specifications or that may be requested by the Contracting Officer and no work shall be fabricated by the Contractor, save at his own risk, until such approval has been given.

b) Drawings and schedules shall be submitted in quadruplicate (unless otherwise specified) accompanied by letter of transmittal which shall give a list of the numbers and dates of the drawings submitted. Drawings shall be complete in every respect and bound insets.

c) The Contractor shall submit all drawings and schedules sufficiently in advance of construction requirements to allow ample time for checking, correcting, resubmitting and rechecking.

d) The drawings submitted shall be marked with the name of the project, numbered consecutively and bear the stamp of approval of the Contractor as evidence that the drawings have been checked by the Contractor. Any drawings submitted without this stamp of approval will not be considered and will be returned to the Contractor for

resubmission. If the shop drawings show variations from the requirements of the contract because of standard shop practice or other reasons, the Contractor shall make specific mention of such variation in his letter of transmittal in order that if applicable, suitable action may be taken for proper adjustment. Otherwise, the Contractor will not be relieved of the responsibility for executing the work in accordance with the contract even though such shop drawings have been approved.

e) If a drawing as submitted indicates a departure from the contract requirements which the Contracting Officer finds to be in the interest of the Owner and to be so minor as not to involve a change in the contract price or time for performance, he may approve the drawings.

f) The approval of shop and setting drawings will be general and, except as otherwise provided in paragraph 2 (e), shall not be construed (1) as permitting any departure from the contract requirements; (2) as relieving the Contractor of the responsibility for any error in details, dimensions or otherwise that may exist; (3) as approving departures from additional details or instructions previously furnished by the Contracting Officer.

3. Standards

a) Any material specified by reference to the number, symbol or title of a specific standard, such as a commercial standard, a Federal specification, a trade association standard or other similar standard, shall comply with the requirements in the latest revision thereto in effect on the date of Invitation for Bids, except as limited to type, class or grade or modified in such reference.

b) The standard referred to, except as modified in the specifications, shall have full force and effect as though printed in the specifications. These standards are not furnished to bidders for the reason that the manufacturers and trades involved are assumed to be familiar with their requirements. The Contracting Officer will furnish, upon request, information as to how copies of such standards may be obtained.

c) Reference in the specifications to any article, device, product, material, fixture, form, or type of construction by name, make or catalog number shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition; and the Contractor, in such cases, may at his option use any article, device, product, material, fixture, form of type of construction which in the judgment of the Contracting Officer expressed in writing is equal to that specified.

4. Samples

a) The Contractor shall furnish for the approval of the Contracting Officer any samples

required by the specifications or that may be required by the Contracting Officer of any and all materials or equipment he proposes to use and shall prepay all shipping charges on the samples.

b) No samples are to be submitted with bids.

c) No materials or equipment of which samples are required to be submitted for approval shall be used on the work until such approval has been given by the Contracting Officer, save only at the Contractor's risk and expense.

d) Each sample shall have a label indicating the material represented, its place of origin and the names of the producer, the Contractor and the building or work for which the material is intended. Samples of finished materials shall be so marked as to indicate where the materials represented are required by the drawings or specifications.

e) A letter in duplicate submitting each shipment of samples shall be mailed under separate cover by the Contractor and contain a list of the samples, the name of the building or work for which the materials are intended, and the brands of the materials and names of the manufacturers.

f) The approval of any sample shall be only for characteristics or for the named in such approval and no other. No approval of a sample shall be taken in itself to change or modify any contract requirement. When a material has been approved, no additional sample of that material will be considered and no change in brand or make will be permitted. Approval of samples of hardware in good condition may be suitably marked for identification and used in the work.

g) Failure of any material to pass the specified tests will be sufficient cause for refusal to consider under this contract any further samples of the same brand or make of that material.

h) Test samples as the Contracting Officer may deem necessary will be procured from the various materials or equipment delivered by the Contractor for use in the work. If any of these test samples fail to meet the specifications requirement, any previous approvals will be withdrawn and such materials or equipment shall be subject to removal and replacement by the Contractor with materials or equipment meeting the specification requirements, or at the discretion of the Owner, the defective materials and equipment may be permitted to remain in place subject to a proper adjustment of the contract price. The cost of the tests will be borne by the Owner except where laboratory tests as hereinafter specified are required by the specifications.

5. Operations and Maintenance Data

e) Submit operation and maintenance (O&M) data/manuals which are specifically

applicable to this contract and a complete and concise depiction of the provided equipment or product. Data containing extraneous information to be sorted through to find applicable instructions will not be accepted. Present information in sufficient detail to clearly explain user O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal.

b) Types of information required in O&M data packages

1. Operating Instructions: Include specific instructions, procedures, and illustrations.

2. Safety Precautions: List personnel hazards and equipment or product safety precautions for all operating conditions.

3. Startup, Shutdown, and Post shutdown Procedures: Include a control sequence for each of these operations.

4. Normal Operations: Include control diagrams with data to explain operation and control of systems and specific equipment.

5. Emergency Operations: Include emergency procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include emergency shutdown instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance on emergency operations of all utility systems including valve locations and portions of systems controlled.

6. Operator Service Requirements: Include instructions for services to be performed by the operator such as lubrication, adjustments, and inspection.

7. Environmental Conditions: Include a list of environmental conditions (temperature, humidity and other relevant data) which are best suited for each product or piece of equipment and describe conditions under which equipment should not be allowed to run.

8. Preventive Maintenance Plan and Schedule: Include manufacturer's schedule for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation and to minimize corrective maintenance and repair.

9. Trouble shooting Guides and Diagnostic Techniques: Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought.

Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or requires replacement.

10. Wiring Diagrams and Control Diagrams: Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation numbering.

11. Maintenance and Repair Procedures: Include instructions and list tools required to restore product or equipment to proper condition or operating standards.

12. Removal and Replacement Instructions: Include step-by-step procedures and list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include a combination of text and illustrations.

13. Spare Parts and Supply Lists: Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays.

14. Parts Identification: Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items.

15. Warranty Information: List and explain the various warranties and include the servicing and technical precautions prescribed by the manufacturers or contract documents to keep warranties in force.

6. Laboratory and Other Field Tests

Any specified laboratory and field tests of materials and finished articles to be incorporated in the work shall be made by bureaus, laboratories or agencies approved by the Contracting Officer, and the reports of such tests shall be submitted to the Contracting Officer. The cost of the testing shall be paid for by the Contractor. The tests shall include, but are not limited to, compaction testing, concrete slump, and other field tests needed in the construction process.

7. Methods

The Contractor shall use proper and efficient methods and appliances for the performance of all the operations connected with work embraced under these specifications, drawings and contract to secure a rate of progress which will secure completion of the work within the time specified. If, at any time before commencement of work, or during the progress thereof, such methods, equipment or appliances are inefficient or inappropriate for securing said quality of work or said rate of progress, the Contracting Officer may order the Contractor to increase their efficiency or to improve their character, and the Contractor must conform to such order. The failure of the Contracting Officer to demand such increases of efficiency or improvement shall not relieve the Contractor or his sureties from the obligations to secure such quality of work and said rate of progress and the completion of the work as required herein.

8. Labor and Materials

The Contractor shall furnish all labor, materials and equipment for the execution of the work according to the drawings, specifications and contract, and where no specifications are contained therein for whatever may be necessary, shall do all that may be termed ordinary, customary or essential to a job to be well and reliably completed. This includes concealment of all pipes and other rough items of installation if not clearly so shown on the drawings in a manner acceptable to the Contracting Officer. Structural safety shall not be impaired by such concealment. Work not particularly detailed, marked or specified shall be of equal quality as similar parts that are detailed, marked or specified. All material finished for and used in the job shall be of kind and grade specified and where not specifically called for at least of customary standard grade. All work shall be executed in accordance with their trades. Full structural safety is essential and the Contractor guarantees to accomplish same for the entire work.

9. Guarantee of Work

a) Except as otherwise specified all work shall be guaranteed by the Contractor against defects resulting from the use of inferior materials, equipment, or workmanship for one year from the date of final completion of the contract or from full occupancy of the building or work product by the Owner, whichever is earlier.

b) If within any guarantee period, repairs or changes are required in connection with guaranteed work which, in the opinion of the Contracting Officer, is rendered necessary as the result of the use of materials, equipment or workmanship which are inferior, defective or not in accordance with the terms of the contract, the Contractor shall promptly upon receipt of notice from the Owner and without expense to the Owner:

1. Place in satisfactory condition in every particular all of such guaranteed work and correct all defects therein; and

2. Make good all damages to the building or site or equipment or contents thereof which, in the opinion of the Contracting Officer, are the result of the use of materials, equipment or workmanship which are inferior, defective or not in accordance with the terms of the contract.

c) In any case wherein fulfilling the requirements of the contract or of any guarantee embraced in or required thereby the Contractor disturbs any work guaranteed under another contract, he shall restore such disturbed work to a condition satisfactory to the Contracting Officer and guarantee such restored work to the same extent as it was guaranteed under such other contract.

d) If the Contractor, after notice, fails to proceed promptly to comply with the terms of the guarantee, the Owner may have the defects corrected and the Contractor and his surety shall be liable for all expense incurred.

e) All special guarantees applicable to definite parts of the work shall be stipulated in the specifications or other papers forming a part of the contract and shall be subject to the terms of this paragraph during the first year of the life of such special guarantee.

10. Defective Work

No work or material which may be defective in construction or quality or deficient in any of the requirements of the drawings and specifications will be considered accepted as a consequence of the failure of the Contracting Officer or the inspectors to discover or to point out said defects or deficiencies during the construction; nor will the presence of inspectors on the work relieve the Contractor from the responsibility of securing the quality and progress of work as required by these specifications.

Any defective work that may be discovered before the completion of the work or within such time as required by the bond shall be replaced by work and materials that shall conform to the spirit and intent of the drawings, specifications and contract.

The fact that the Contracting Officer or his representatives may have overlooked defective work shall not constitute the acceptance of work. NO PAYMENT WHETHER PARTIAL OR FINAL SHALL BE CONSTRUED TO BE AN ACCEPTANCE OF DEFECTIVE WORK OR IMPROPER MATERIALS.

The Contracting Officer may at any time by order given in writing stop any work not being done according to drawings and specifications and any order so given shall not in any way relieve the Contractor from completing his contract and shall not in any way terminate, cancel or abrogate the contract or any part thereof, and the Government of Guam shall not in any way be responsible for the delay due to stopping the work as aforesaid.

VI. INSPECTION OF WORK

1. Access to the Work

The Contracting Officer and his representatives shall have access at all times to the work for inspection whatever it is in preparation or progress and the Contractor shall provide proper facilities for such access and inspection.

2. Inspectors

Inspectors may be placed by the Contracting Officer to supervise each and every subdivision of the work or any parts or process thereof. The Contracting Officer and the inspectors shall have free access to all parts of the work at all times and shall be given every facility, information and means of thoroughly inspecting the work done and the materials used or to be used.

The inspectors shall at all times be free to perform their duties and any intimidation of any inspector by the Contractor or the employees thereof shall be sufficient reason, if the Owner shall so decide, to annul the contract.

3. As-Built Drawings

A contract set of drawings shall be maintained at the site with all changes or deviations from the original drawings neatly marked thereon in brightly contrasting color. Also, the final location of piping, fittings, valves and accessories, along with utilities encountered in the trench or other excavations shall be indicated. This shall be a separate set of drawings not used for construction purposes which shall be kept up to date as the job progresses and shall be made available for inspection by the Contracting Officer at all times. Upon completion of the contract this set of drawings and another copy in the latest AutoCAD format provided in compact discs shall be delivered to the Contracting Officer.

4. Inspection

a) All materials and workmanship (if not otherwise designated by the specifications) shall be subject to inspection, examination and testing by the Contracting Officer at any and all times during manufacture and/or construction and at any and all places where such manufacture and/or construction are carried on. The Contracting Officer shall have the right to reject defective material and workmanship or require its correction. Rejected workmanship shall be satisfactorily corrected, and rejected materials shall be satisfactorily replaced with proper materials and the Contractor shall promptly segregate and remove the rejected materials from the premises. If the Contractor fails to proceed at once with the replacement of rejected materials and/or the correction of defective workmanship, the Owner may, by contract or otherwise, replace such materials and/or correct such workmanship and charge the cost to the Contractor, or may terminate the right of the Contractor to proceed as provided in paragraph 6 of Section VII, Time for Performance, the Contractor and surety being liable for any damage to the same extent as provided in said paragraph 6 for termination thereunder.

b) The Contractor shall furnish promptly, without additional charge, all reasonable facilities, labor and materials necessary for the safe and convenient inspection and tests that may be required by the Contracting Officer. All inspections and tests shall be performed in such manner as not to unnecessarily delay the work. Special, full-size and performance tests shall be as described in the specifications. The Contractor shall be charged with any cost of inspection when material and workmanship are not ready at the time inspection is requested by the Contractor.

c) Should it be considered necessary or advisable by the Contracting Officer at any time before final acceptance of the entire work to make an examination of work already completed by removing or tearing out same, the Contractor shall on request promptly furnish all necessary facilities, labor and materials. If such work is found to be defective in any material respect due to the fault of the Contractor or his subcontractors, he shall defray all the expenses of such examination and of satisfactory reconstruction. If, however, such work is found to meet the requirements involved in the examination and replacement, the cost of conducting the test plus 15% shall be allowed the Contractor and he shall in addition, if completion of the work has been delayed thereby, be granted a suitable extension of time on account of the additional work involved.

5. Final Inspection

a) When the work is substantially completed the Contractor shall notify the Owner, in writing, that the work will be ready for final inspection and test on a definite date which shall be stated in such notice. The notice shall be given at least ten (10)

calendar days in advance of said date and shall be forwarded through the Contracting Officer who will attach his endorsement as to whether or not he concurs in the Contractor's statement that the work will be ready for final inspection or tests on the date given but such endorsement shall not relieve the Contractor of this responsibility in the matter.

b) If the Contracting Officer considers the work substantially complete, the Contracting Officer shall therein fix the date of substantial completion. In addition, a list of any deficiencies requiring completion or correction before final inspection will be attached to the Certificate of Substantial Completion. This list of deficiencies (punch list) shall be completed by the Contractor within 10 days after receipt of the Certificate of Substantial Completion and list of deficiencies. The Contracting Officer will not make the final inspection until all work, including the correction of such deficiencies, final clean-up, and such extra work as may be ordered by the Contracting Officer, has been completed by the Contractor and all subcontractors.

c) When the Contractor has completed work listed on the punch list or when the 10 day punch list period expires, whichever comes first, the Contracting Officer will set a definite date for final inspection. The Contracting Officer and Contractor will then make a final inspection of the project, again noting any deficiencies that remain. The Contracting Officer will again notify the Contractor in writing of all particulars in which this inspection reveals that the work is incomplete or defective. The Contractor shall remedy such deficiencies within 5 days of written notice.

Upon correction of all deficiencies, the Contracting Officer will notify the Contractor and Owner in writing of the date upon which the work was considered complete.

d) A Certificate of Completion for the project, submitted by the Contracting Officer and approved by the Owner, shall constitute final acceptance of the work.

e) Final acceptance shall not constitute acceptance of any unauthorized or defective work or material, nor shall progress estimates be construed as acceptance of any work under this contract. The Owner shall not be barred from requiring the Contractor to remove, replace, repair, or dispose of any unauthorized of defective work or from recovering damages for any such work or material.

VII. TIME FOR PERFORMANCE

1. Prosecution of the Work

The Contractor agrees that said work shall be prosecuted regularly, diligently and without interruption at such rate of progress as will insure full completion thereof within the time specified. It is expressly understood and agreed by and between the Contractor and the

Owner that the time for completion of the same takes into consideration the average climatic range and usual industrial conditions prevailing in the locality.

2. Suspension of Work

The Owner will furnish all land and rights-of-way necessary for the carrying out of this contract and the completion of the work herein contemplated. Should the Owner be prevented or enjoined from proceeding with the work or from authorizing its prosecution, either before or after the commencement by reason of any litigation, the Contractor shall not be entitled to make or assert any claim for damage by reason of said delay, or to withdraw from the contract except by consent of the Owner, but time for completion of the work will be extended to such time as the Owner determines will compensate for the time lost by such delay determination to be set forth in writing.

3. Climatic Conditions

a) When so ordered by the Contracting Officer, the Contractor shall suspend any work that may be subject to damage by climatic conditions.

b) Contract Completion Time. The allowable work days for this contract were calculated after allowing for the following number of lost days in each month. Time extension on account of inclement weather will be allowed only if the daily report of the Contracting Officer's inspector indicates lost days beyond the limits shown below. Time extension on account of inclement weather on Saturday and Sunday shall be granted only if the Contractor confirms in writing at least seven (7) calendar days in advance his intention to work on weekends.

Month	Non-Working Days
January	07
February	05
March	05
April	04
May	05
June	06
July	10
August	11
September	12
October	10
November	07
December	07

4. Progress Meeting and Progress Report

The Contractor must make himself available to meet with the Contracting Officer once a week

to report and discuss the project progress, problem areas encountered, and planning of future work. The Contractor shall submit monthly progress report in triplicate to the Contracting Officer briefly setting forth work accomplished within two days after meeting.

5. Time Restrictions for Performing Work

No work shall be carried out on Site during the night or on Saturdays, Sundays, or legal holidays without the consent in writing of the Contracting Officer except if the Work is unavoidable or absolutely necessary to save life or property or for the safety of the Work, in which case the Contractor shall immediately advise the Contracting Officer. The Contracting Officer shall not unreasonably withhold any such consent under exceptional circumstances, nor do so if Work at night or on Saturdays, Sundays, or legal holidays is considered by Contractor to be necessary to meet the Contract Time. The services of the Inspector and Project Engineer will be charged to the Contractor.

6. Owner's Right to Stop Work or Terminate Contract, Delays, Damages

a) If:

1. The Contractor shall be adjudged bankrupt or make an assignment for the benefit of creditors;

2. A receiver or liquidator shall be appointed for the Contractor or for any of his property and shall not be dismissed within 20 calendar days after such appointment, or the proceedings in connection therewith shall not be stayed on appeal within the said 20 calendar days;

3. The Contractor shall refuse or fail, after Notice of Warning from the Contracting Officer, to supply enough properly skilled workmen or proper materials; or

4. The Contractor shall refuse to prosecute the work or any part thereof with such diligence as will insure its completion within the period herein specified (or any duly authorized extension thereof) or shall fail to complete the work within said period, or;

5. The Contractor shall fail to make payments as specified to persons supplying labor or materials for the work, or;

6. The Contractor shall fail or refuse to regard laws, ordinances or the instructions of the Contracting Officer or otherwise be guilty of a substantial violation of any provisions of this contract, then, and in any such event, the Owner, upon the certificate of the Contracting Officer that sufficient cause exists to justify such action, and without prejudice to any other rights or

remedy he has may, with 10 calendar days notice to the Contractor, terminate the employment of the Contractor and his right to proceed, either as to the entire work or (at the option of the Owner) as to any portion thereof as to which delay shall have occurred, and may take possession of the work and complete the work by contract or otherwise as the Owner may deem expedient. In such case the Contractor shall not be entitled to receive any further payment on that work until the work is finished. If the unpaid balance of the compensation to be paid the Contractor hereunder shall exceed the expense of so completing the work (including compensation for additional managerial, administrative, and inspection services and any liquidated damages for delay), such excess shall be paid to the Contractor. If such expense shall exceed such unpaid balance, the Contractor and his sureties shall be liable to the Owner for such excess. If the right of the Contractor to proceed with the work is so terminated, the Owner may take possession of and utilize in completing the work such materials, supplies, plant, and equipment as may be on the site of the work and necessary therefore. The expenses incurred through the Contractor's default shall be certified by the Contracting Officer.

b) If the Owner does not terminate the right of the Contractor to proceed, the Contractor shall continue the work, in which event the Contractor shall pay to the Owner as fixed, agreed, and liquidated damages for each calendar day of the delay until work is completed or accepted the amount as set forth in the section of the specifications and the Contractor and his sureties shall be liable for the amount thereof.

c) Provided that the right of the Contractor to proceed shall not be terminated, or the Contractor charged with liquidated damages because of any delays in the completion of the work due to unforeseeable cause beyond the control and without the fault or negligence of the Contractor including, but not restricted to, acts of God or of the public enemy, acts of the Owner, acts of another Contractor in the performance of a contract with the Owner, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and unusually severe weather, or delays of subcontractors due to such cases, if the Contractor shall, within ten days from the beginning of any such delay (unless the Owner shall grant a further period of time prior to the date of final settlement of the contract) notify the Owner in writing through the Contracting Officer of the causes of delay, who shall ascertain the facts and the extent of the delay and extend the time for completing the work when in his judgment the findings of facts justify such an extension, and his findings of fact thereon shall be final and conclusive on the parties hereto subject only to arbitration as specified herein.

VIII. CLAIMS, PAYMENTS

1. Contractor's Title to Materials

No materials or supplies for the work shall be purchased by the Contractor or by any subcontractor subject to any chattel mortgage or under a conditional sale or other agreement by which an interest is retained by the seller. The Contractor warrants that he has good title to all materials and supplies for which he accepts partial payments.

2. Claims

The Contractor agrees whenever required to do so by the Owner to furnish satisfactory evidence that all persons, firms or corporations who have done work or supplied materials under these specifications have been paid or have been duly notified of the completion of the work and have been secured to their satisfaction before the said Contractor shall be entitled to final payment.

In case such evidence is not furnished or in case any claim is filed with the Owner or any suit or action is instituted against the Owner as defendant or garnishes or against the Contractor in connection with the work performed or to be performed under the drawings, specifications or contract, the Owner may retain from the money due or to become due to the Contractor such sum or sums as in the judgment of the Contracting Officer will fully protect the Owner from loss, charge or expense by reason of such claim, suit or action. The Owner without prejudice to any other and further rights, may make any and all deductions for any loss, charge or expense sustained by it to which it would be entitled under the contract specifications or bond, or otherwise before paying over the balance of the sum or sums retained as aforesaid, if any, to the Contractor, his creditor, or any successful claimant against the Contractor.

No payment made or retained under this contract shall be held to relieve the Contractor and/or his sureties from his and/or their obligations under this bond to hold harmless and indemnify the Owner or its agents from any and all loss, charge or expense by reason of any unpaid claim whatsoever.

3. Waiver of Mechanics Liens

Contractor waives any right that he now has or in the future may have to claim a mechanic's lien against the real property or improvements thereon which are the subject of this contract, to secure payment for labor and materials furnished or to be furnished by him under this contract.

4. Schedule of Values

Within three days after receipt of notice to proceed, the Contractor shall submit for approval a schedule of the estimated values of the main branches of the work totaling the amount of the contract. The format to be used will be furnished by the Contracting Officer. These values

will be used for determining partial payments and as a basis for changes in work as outlined in the General Conditions.

5. Taxes

The Contractor shall, without additional expense to the Owner, pay all applicable taxes. The successful bidder will be required to comply with the applicable sections of Titles 11 and 21 of the Guam Code Annotated, as regards to licenses and taxes. In addition to the general contractor's liability, subcontractors are also subject to these provisions. Subcontractors are also required to possess Guam Service Licenses. The Contractor will be required to submit a list of his subcontractors and the monetary amount of each subcontract.

6. Materials, Services and Facilities

It is understood that except as otherwise specifically stated in the contract documents, the Contractor shall provide and pay for all materials, labor, tools, equipment, water, light, power, transportation, superintendence, temporary construction of every nature whatsoever necessary to execute, complete and deliver the work within the specified time.

7. Patents

The Contractor shall hold and save the Owner and his officers, agents, servants, and employees harmless from liability of any nature or kind, including cost and expenses, for or on account of any patented or unpatented invention, process, article or appliance manufactured or used in the performance of the contract including its use by the Owner, unless otherwise specifically stipulated in the contract documents.

8. Payment by Contractor

The Contractor shall pay -

a) for all transportation and utility services not later than the 20th day of the calendar month following that in which such services are rendered;

b) for all materials, tools, and other expendable equipment to the extent of 90% of the cost thereof, not later than the 20th day of the calendar month following that in which such materials, tools and equipment are delivered at the site of the project, and the balance of the cost thereof not later than the 30th day following the completion of that part of the work in or on which such materials, tools and equipment are incorporated or used;

c) to each of his subcontractors, not later than the 5th day following each payment to the Contractor, the respective amounts allowed the Contractor on account of the

work performed by his subcontractors, to the extent of such subcontractor's interest therein.

9. Extras

Except as otherwise herein provided, no charge for any extra work or materials will be allowed unless the same has been ordered in writing by the Owner and either the price is stated in such order or a definite acknowledgment is made that a change in price is involved subject to later determination.

10. Changes in Work

a) The Owner may at any time, by a written order, and without notice to the sureties, make changes in the drawings and specifications of this contract and within the general scope thereof. However, no change will be made which increases the total contract price without notice to sureties. In making any change, the charge or credit for the change shall be determined by the following method:

1. The actual cost of:

I. Labor, including foreman
II. Materials entering permanently into the work
III. Equipment rental cost during time used on extra work
IV. Power and consumable supplies
V. Insurance
VI. To the above cost there shall be added a fixed fee to be agreed upon, but not to exceed 15% of the net cost. This fee shall be compensation to cover the cost of supervision, overhead, bond, profit and other general expenses.

b) The Contractor shall, when required by the Owner, furnish to the Owner an itemized breakdown of the quantities and prices used in computing the value of any change that might be ordered.

c) In figuring changes, instructions for measurement of quantities set forth in the specifications shall be followed.

d) If any part of the work as installed is at variance with the contract requirements, the Owner may, if he finds it to be in his interest, allow all or any part of such work to remain in place subject to a proper adjustment in the contract price.

11. Payment to Contractor

a) Unless otherwise provided in the specifications, the Owner will make partial payments to the Contractor after receipt and approval of the request for partial payment covering the work performed during the proceeding calendar month. No payments for installed materials on the site will be made unless such request is accompanied by a receipt or certification showing that the Contractor has made payment in full for such work done. In preparing such estimates, preparatory work done shall not be considered for payment. Materials delivered to site shall be considered for payment subject to the following conditions:

1. The material shall be kept in a safe and enclosed warehouse or area located on site with restricted access.

2. The receipt and issue of material must be controlled by a stock card kept in the warehouse.

3. Insurance coverage required under Section 11, Chapter IV of the General Conditions shall include insurance of such material and shall include theft insurance.

4. Request for payment must be accompanied with certification and receipts indicating the cost of material and showing that Contractor has made full payment for such material.

b) In making such partial payments there shall be retained ten percent (10%) of the estimated amount until final completion and acceptance of all work covered by the contract. However, if the Contracting Officer, at any time after 50% of the work has been completed, finds that satisfactory progress is being made, he may authorize payment in full of each progress payment for work performed beyond the 50% stage of completion. Also, whenever the work is substantially complete, the Contracting Officer, if he considers the amount retained to be in excess of the amount adequate for the protection of the Government, at his discretion, may release to the Contractor all or a portion of such excess amount.

c) All materials and work covered by partial payments made shall thereupon become the sole property of the Owner, but this provision shall not be construed as relieving the Contractor from the sole responsibility for all materials and work upon which payment have been made, or the restoration of any damaged work or as a waiver of the right of the Owner to require the fulfillment of all of the terms of the contract.

d) Release of Claims - Neither the final payment or any part of the retained percentage shall become due until the Contractor shall deliver to the Owner through the Contracting Officer a complete release of all claims against the Owner arising under and by virtue of this contract, including claims of all subcontractors and suppliers of

either materials or labor, other than such claims, if any, as may be specifically excepted by the Contractor.

e) Certificate of Completion - Upon completion and acceptance of all work whatsoever required and the release of all claims against the Owner as specified, the Contracting Officer shall file a written certificate with the Owner and with the Contractor as to the entire amount of work performed and compensation earned by the Contractor, including extra work and compensation therefore.

f) Final Payment - Within thirty (30) calendar days after the filing of such certificate of completion, the Owner shall pay to the Contractor the amount therein stated less all prior payments and advances whatsoever to or for the amount of the contract. All prior estimates and payments including those relating to extra work shall be subject to correction by this payment which is throughout this contract called Final Payment.

g) Acceptance of Final Payment Constitutes Release - The acceptance by the Contractor of the final payment shall be and shall operate as a release to the Owner of all claims and of all liability to the Contractor for all things done or furnished in connection with this work and for every act and neglect of the Owner and others relating to or arising out of this work, excepting the Contractor's claims for interest upon the final payments if this payment be improperly delayed. No payments, however, final or otherwise shall operate to release the Contractor or his sureties from any obligations under this contract or the performance and payment bonds.

IX. MISCELLANEOUS

1. Prohibited Interests

a) No member of or Delegate to Congress or Resident Commissioner, shall be admitted to any share or part of this contract or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this contract if made with a corporation for its general benefit.

b) No official of the Owner who is authorized in such capacity and on behalf of the Owner to negotiate, make, accept or approve, or to take part in negotiating, making, accepting or approving any architectural, engineering, inspection, construction or material supply contract or any subcontract in connection with the construction of the project, shall become directly or indirectly interested personally in this contract or in any part hereof. No officer, employee, architect, attorney, engineer, or inspector of or for the Government of Guam authorized to exercise any legislative, executive supervisory or other similar functions in connection with the construction of the project, shall become directly or indirectly interested personally in this contract or in

any part thereof, any material supply contract, subcontract, insurance contract, or any other contract pertaining to the project.

2. Disputes

a) Except as otherwise provided in this contract, any disputes arising under this contract shall be decided by the Contracting Officer, who shall reduce his decision to writing and mail or otherwise furnish a copy thereof to the Contractor. The decision of the Contracting Officer shall be final and conclusive. The provision shall not be pleaded in any suit involving a question of facts arising under this contract as limiting judicial review of any such decision to cases where fraud by such official or his representative is alleged. Provided, however, that any such decision shall be final and conclusive unless the same is fraudulent or capricious or arbitrary or so grossly erroneous as necessarily to imply bad faith or is not supported by substantial evidence.

b) This "Disputes" clause does not preclude consideration of questions of law in connection with decisions provided for in paragraph (2) above. Nothing in this contract, however, shall be construed as making final the decision of any administrative official representative or board on a question of law.

•Guam Community College
Apprenticeship Program
P.O. BOX 25069
GUAM MAIN FACILITY, GUAM 96921
Telephone: 735-5605/5572
Fax: 734-1002

APPLICATION

INSTRUCTIONS: Please type or print in ink required information, fully and completely. The information given must be true and correct; false statements will result in termination from the Apprenticeship Training Program. For questions that do not apply to you, write or type N/A (Not Applicable).

REQUIRED DOCUMENTS:

1. High School Transcript or
2. GED Certificate of
3. College Transcript or
4. Letter of Recommendation from Employer

QUALIFICATIONS FOR APPRENTICESHIP TRAINING PROGRAM:

- Must be a U.S. Citizen/resident alien;
- Must be 17 years of age or older;
- Must be a High School Graduate or General Education Development (GED) Completer;
- Must be Directly Referred by Employer

1. Name (Last) (First) Middle Initial)	2. Social Security Number	3. Trade Interested In
4. Mailing Address		5. Date Applied
6. Home Address	7.Home Phone	8. Work Phone

9. List current License and Registration pertinent to position applied for:

Type _____ Licensing Authority _____
Expiration Date: _____

10. Required data for Federal Report(s)

A. Date of Birth _____
B. Sex: Male _____Female _____
C. Citizenship _____ Green Card Number _____
D. Nationality _____

EDUCATION AND TRAINING

11. Education (Circle last grade completed) 6 7 8 9 10 11 12 13	12. GED CERTIFICATE A. Received 20_____ B. By:_____ A. Received 20_____ B. By:_____

13. Name and Location of Last School attended _____
Graduated? _____Yes _____No

_____Year

14. OTHER SCHOOLS OR TRAINING (Trade, Vocational, Armed Forces, or Business). Give name and location and dates attended, subjects studied, certificate received, and any other pertinent data.

_____

_____

15. SPECIAL INFORMATION FOR VETERANS. Are you a veteran of the Armed Forces and eligible for G.I. Benefits?

_____ Yes (Submit DD214) _____ No

Date(s) of Military Service: FROM_____TO_____
BRANCH_____

Attachment "A", Page 1
WORK HISTORY

Instructions: This portion must be accurate and complete. Application lacking sufficient information will be rejected. List your entire work history, including part-time and temporary jobs, in reverse order, starting with your present or last job. List each promotion as a separate job.

16A. Date of Employment (Month and Year) From_____To_____	Name and Address of Employer	Salary Start_____Per_____ Present_____Per_____
Name and title of immediate supervisor	Exact title of your own position	
Type of business (Manufacturing, Selling, etc.)	Reason for Wanting to Leave	

Describe in detail the duties that you performed:

16B. Date of Employment (Month and Year) From_____To_____	Name and Address of Employer	Salary Start_____Per_____ Present_____Per_____
Name and title of immediate supervisor	Exact title of your own position	
Type of business (Manufacturing, Selling, etc.)	Reason for Wanting to Leave	

Describe in detail the duties that you performed:

16C. Date of Employment (Month and Year) From_____To_____	Name and Address of Employer	Salary Start_____Per_____ Present_____Per_____

Name and title of immediate supervisor	Exact title of your own position
Type of business (Manufacturing, Selling, etc.)	Reason for Wanting to Leave

Describe in detail the duties that you performed:

17. Do you understand you must attend classes in related theoretical instructions required for your apprenticeship term?_____

Do you understand that trades are seasonal and some unemployment each year may be possible?_____

I CERTIFY THAT THE FOREGOING STATEMENTS ARE TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE.

_____

SIGNATURE/DATE

AFFIRMATIVE ACTION EQUAL OPPORTUNITY TITLE IX AGENCY

Guam Community College affirms the right of all individuals to equal opportunity in education and employment without regard race, color, religion, age, national origin, or disability. The College is committed to comply with all territorial and federal statutes, rules and regulations, which prohibit discrimination in its policies and practices and which requires Affirmative Action, including but not limited to Title VI and Title VII of the Civil Rights Act of 1964, section 503 and section 504 of the Rehabilitation Act of 1973, Section 402 of the Vietnam Era Veterans Education Amendments, the Equal Pay Act of 1963, Executive Order 11246, as amended, and The Age Discrimination Act of 1975. Inquiries should be directed to the EEO/Civil Rights Officer, Guam Community College, P.O. Box 25069, G.M.F., Guam 96921 Telephone 735-5500.

Common Construction Prevailing Wage Rates for Guam

OCCUPATION	HOURLY RATE
Bricklayer	$14.02
Carpenter	$13.56
Cement Mason	$12.87
Construction Equipment Mechanic	$14.14
Cook, Camp	$11.85
Electrician	$15.45
Heating, Air Conditioning & Refrigeration Mechanic	$15.73
Operating Engineer (Heavy Equipment Operator)	$13.77
Painter	$14.60
Pipefitter	$16.80
Plasterer	$10.98
Plumber	$14.96
Reinforcing Metal Worker	$12.56
Sheet Metal Worker	$15.17
Structural Steel Worker	$13.22
Surveyor Helper	$15.98
Welder	$16.09

GENERAL SCOPE OF WORK

1. SCOPE: The work shall consist of furnishing all labor, equipment, tools and materials to build the new Dededo Indoor Substation. The extent of work includes the following as indicated on the plans:

   1.1 Earthwork for equipment and material installation.

   1.2 Chain link fence and gate.

   1.3. Concrete Pavement.

   1.4 Laying of 6-inch crushed rocks.

   1.5 Oil containment system.

   1.6 Furnish and install electrical raceway system.

   1.7 Control Building

   1.8 13.8 kV Switchgear

   1.9 34.5 kV Switchgear

   1.10 Installation of Power Transformer

   1.11 SCADA System

   1.12 Furnish and install all power control and cables.

   1.13 Furnish and install equipment and materials such as steel structures, 34.5 kV disconnect switch, power cables, surge arresters, substation terminals, control cables, and other associated materials.

   1.14 Receive, unload, transport, store, and install owner furnished equipment and materials such as power transformer, and concrete poles.

   1.15 Lightning Protection System and all power and control cables.

   1.17 Grounding system.

   1.17 Perform testing.

2. LOCATION: The work will be performed at the Dededo Substation. Bidders shall visit the jobsite prior to bidding of the project. Any discrepancies in the drawings and specifications shall be

reported to GPA prior to the bid opening.

3. DRAWINGS: The following list constitutes the basic contract drawings:

DRAWING SHEET NO.	DESCRIPTION
T1.0	Title Sheet
C1.0	General Notes, Legend and Symbols
C2.0	Demolition Plan
C3.0	Site Geometric Plan
C3.1	Site Improvement Plan
C4.0	Sections and Details
C4.1	Retaining Wall Profile
MD1.0	Miscellaneous Details
MD2.0	Miscellaneous Details
MD3.0	Chain Link Fence and Gate Details
A1.0	Architectural Site Plan
A1.1	Floor Plan and Room Finish Schedule
A1.2	Reflected Ceiling and Roof Plan
A2.1	Building Elevations
A3.1	Building Sections and Door Schedule
A4.1	Wall Sections
A5.1	Miscellaneous Details
S0.1	Structural Design Criteria, General Notes, and Typical Detail
S0.2	Typical Details
S1.1	Foundation Plan
S1.2	Lower Roof and Main Roof Framing Plan
S2.1	Sections
S2.2	Sections
S2.3	Sections and Typical Details
S3.1	Column Schedule and Schedule Details
S4.1	Wall Schedule and Typical Details
S5.1	Typical Beam Details
S5.2	Typical Beam Elevations
S6.1	Miscellaneous Details
M1.0	Air Conditioning and Ventilation Plan
M2.0	Mechanical Room Enlarged Plan and Sections
M3.0	Refrigerant Piping Isometrics, CO2 Sensor and OA Damper Operation Schematic and Details
P1.0	Plumbing Plan, Isometric, Schematic, Legend
P2.0	Details
E1.0	Electrical Symbol List, Abbreviations
E2.0	Electrical Site Removal Plan
E2.1	Electrical Site New Plan
E3.0	Substation Grounding Plan

E3.1	Substation Lightning Protection Plan
E4.0	Lighting Plan
E4.1	Power Plan
E4.2	Communication and FA Plan
E5.0	Distribution and Substation Service One Line Diagram
E5.1	Substation One Line Diagram
E5.2	SCADA One Line Diagram
E5.3	Riser Diagrams
E6.0	13.8 kV Switchgear Elevation
E6.1	34.5 kV Switchgear Elevation
E7.0	Schedules
E8.0	34.5 kV Manhole Detail 1 of 2
E8.0A	34.5 kV Manhole Detail 2 of 2
E8.1	13.8 kV Manhole and Miscellaneous Details
E8.2	Grounding Details
E8.3	34.5 kV Riser Details
E8.4	13.8 kV Riser Details
E8.5	Lightning Protection Details
E8.6	Lightning Protection Details

4. SUB-SECTIONS: Specific requirements for the different types of work involved in this project will be detailed in each of the following technical specification sub-sections:

11A Site Work

- 02005 Environmental Protection
- 02010 Maintenance of Traffic
- 02050 Demolition and Removal
- 02100 Razing and Alterations
- 02200 Earthwork
- 02201 Earthwork for Utilities and Structures
- 02203 Base Course for Roads and Driveways
- 02280 Soil Treatment
- 02600 Plant Mix Bituminous Pavement
- 02601 Bituminous Prime Coat
- 02713 Exterior Water Distribution System
- 02720 Storm Drainage System
- 02724 Oil Stop Valve
- 02831 Chain Link Fences

11B Concrete

- 03100 Concrete Formwork
- 03200 Concrete Reinforcement
- 03300 Cast-In-Place Concrete
- 03301 Grouting
- 03412 Precast Prestressed Concrete

11C Masonry
- 04230 Reinforced Unit Masonry
- 04812 Glass Masonry Assemblies

11D Metals
- 05500 Metal Fabrications
- 05501 Miscellaneous Metals

11E Thermal and Moisture Protection
- 07213 Batt Insulation
- 07540 Fluid Applied Roofing
- 07920 Sealants

11F Doors and Windows
- 08110 Steel Doors and Frames
- 08114 Standard Steel Doors
- 08115 Standard Steel Frames
- 08712 Finish Hardware

11G Finishes
- 09212 Plastering
- 09900 Painting

11H Special Construction
- 13283 Removal/Control and Disposal of Paint with Lead

11I Mechanical
- 15000 Mechanical General Requirements
- 15400 Interior Plumbing System
- 15500 Air Conditioning and Ventilation System

11J Electrical
- 16050 Basic Electrical Materials and Methods

11K Contractor Furnished Equipment
- 16052 Contractor-Furnished Equipment and Materials
- 16351 34.5 kV Metal-Clad Switchgear
- 16352 13.8 kV Metal-Clad Switchgear
- 16353 Disconnect Switch 34.5 kV
- 16354 Disconnect Switch 13.8 kV
- 16371 Insulators
- 16372 Surge Arresters
- 16373 Terminators 15 kV and 35 kV
- 16390 Grounding
- 16402 Interior Wiring Systems
- 16405 Station Batteries
- 16406 Battery Charger
- 16510 Lighting System
- 16704 Supervisory Control and Data Acquisition System
- 16802 Conductors
- 16803 35 kV 1000 kcmil AL Underground Conductor, Terminators, and Accessories
- 16804 15 kV 750 kcmil CU Underground Conductor, Terminator, and Accessories
- 16805 Stainless Steel Static Wire

16998 Installation Testing
16999 Energization and Start Up

11L Owner-Furnished Equipment and Materials

16051 Owner-Furnished Equipment and Materials
16355 Power Transformer 34.5/13.8 kV 30 MVA
16374 Concrete Pole

5. BASE BID ITEMS:

Bid Item A1 - Mobilization and Demobilization: Payment for this item shall include all preparatory operations performed by the CONTRACTOR, including, but not limited to, those necessary for the movement of its personnel, equipment, supplies and incidentals to the project site; for the establishment of its field office, buildings, storage facilities, work areas and other facilities necessary for the substation work; securing of all permits and clearances; for premiums on bonds for the project, and for other operations which it must perform or costs it must incur before beginning construction on the various items on the project site. Fifty percent (50%) of cost listed in this bid item associated with withdrawing from the site after completion of work, including CONTRACTOR's personnel, facilities, equipment, cleaning and securing the site will be reserved for demobilization.

Bid Item A2 –Concrete Pavement: Payment for this item shall include the installation of the concrete pavement and driveway including base course, except for pavement for Mobile Substation.

Bid Item A3 – Chain Link Fence: Payment for this item shall include the construction of fence, including trenching, foundation, and backfilling, except portion required for Mobile Substation.

Bid Item A4 – Control Building: Payment for this item shall include all works associated with the control building. This includes structural, architectural, mechanical, plumbing, fire protection, and electrical elements.

Bid Item A5 – Oil Containment System and Drainage System: Payment for this item shall include furnishing and installation of containment, oil/water separator, piping, oilstop valve pit, and drainage improvements.

Bid Item A6 – Installation of Power Transformer: Payment for this item will be for all direct and indirect costs associated with receiving, assembling, installing, wiring, and all other work associated with the owner furnished 30 MVA power transformer.

Bid Item A7 - Control Cables and Wiring: Payment for this item shall include removal of existing cables, furnishing, installing, and terminating new cables, and indirect costs associated with the installation of all power and control cables.

Bid Item A8 – Underground Conduits and Conduit Risers: Payment for this item will be for

all direct and indirect costs associated with the underground ducts including excavating, concrete duct materials, furnishing and installing conduit, #4/0 AWG copper counterpoise ground, backfilling, compacting, and all other work incidental to the underground concrete ducts. This item shall also include all above grade conduit installation and materials.

Bid Item A9 – Manholes: Payment for this item will be for all direct and indirect cost associated with construction and installation of manholes.

Bid Item A10 – Power Cables 34.5 kV: Payment for this item will be for all direct and indirect costs associated with furnishing, installing, and terminating the 34.5 kV cables.

Bid Item A11 – Power Cables 13.8 kV: Payment for this item will be for all direct and indirect costs associated with furnishing, installing, and terminating the 13.8 kV cables.

Bid Item A12 – 13.8 kV Switchgear – Payment for this Item will be for all direct and indirect costs associated with furnishing, receiving, assembling, installing, wiring, final testing, and all other work associated with the 13.8 kV switchgear.

Bid Item A13 – 34.5 kV Switchgear – Payment for this Item will be for all direct and indirect costs associated with furnishing, receiving, assembling, installing, wiring, final testing, and all other work associated with the 34.5 kV switchgear.

Bid Item A14 – SCADA System - Payment for this Item will be for all direct and indirect costs associated with furnishing, receiving, assembling, installing, wiring, final testing, and all other work associated with the SCADA System.

Bid Item A15 - Electrical Testing: Payment for this item will be for all direct and indirect costs associated with electrical testing, checking, analyzing, and certifying equipment functions, including preparations of test procedure and furnishing test equipment.

Bid Item A16 - Grounding and Lightning Protection System: Payment for this item will be all labor, material, and equipment costs associated with the Grounding and Lightning Protection System, except for portion intended for the Mobile Substation.

Bid Item A17 - Testing for Soil Contamination: Payment for this item shall include direct and indirect costs associated with testing and analysis of soil. The contractor shall collect a minimum of eight (8) soil samples located within the project area. Four samples shall be taken at areas covered under base bid, two samples shall be taken at the existing switchyard and two samples shall be taken at the mobile substation pad area. Samples shall be collected prior to excavation activities and at depths between 3-18 inches. An environmental professional (as determined by USEPA All Appropriate Inquiries Rule) shall collect the soil samples. The collected samples shall be analyzed for metals, heavy oils, and polychlorinated biphenyls (PCBs). Results shall be provided to the contracting officer.

6. ADDITIVE BID OPTIONS:

Additive Bid Option B1 – Removal and Disposal of Contaminated Soil from Base Bid Construction Area: Payment for this item shall include direct and indirect costs associated with the removal and disposal of contaminated soil from the Base Bid construction area. Use 20 CY as a basis for bid. If actual volume is less than 85% or more than 115% of 20 CY, the contract price shall be adjusted. Contractor shall submit unit cost per cubic yard as part of the bid which will be used to compute for the price adjustment. Price difference shall be computed for volume in excess of 115% or less than 85% of the allowance.

Additive Bid Option B2 – Demolition and Disposal of Existing Switchyard Equipment: Payment for this item shall include direct and indirect costs associated with the demolition and disposal of existing switchyard equipment.

Additive Bid Option B3 – Removal and Disposal of Contaminated Soil from the Switchyard Area: Payment for this item will be for all direct and indirect costs associated with the removal and disposal of contaminated soil from the switchyard area. Use 10 CY as a basis for bid. If actual volume is less than 85% or more than 115% of 10 CY, the contract price shall be adjusted. Contractor shall submit unit cost as part of the bid which will be used to compute for the price adjustment. Price difference shall be computed for volume above 115% or below 85% of the allowance

Additive Bid Option B4 – Work Related to Mobile Substation: Payment for this item shall include direct and indirect costs associated with the construction of Mobile Substation Pad including associated civil and structural work, lightning protection system, feeders, riser structures, switches, grounding, fence/gates, and 6” layer of crushed rock.

Additive Bid Option B5 – Removal and Disposal of Contaminated Soil from the Mobile Substation Pad Area: Payment for this item will be for all direct and indirect costs associated with the removal and disposal of contaminated soil from the Mobile Substation Pad area. Use 10 CY as a basis for bid. If actual volume is less than 85% or more than 115% of 10 CY, the contract price shall be adjusted. Contractor shall submit unit cost as part of the bid which will be used to compute for the price adjustment. Price difference shall be computed for volume above 115% or below 85% of the allowance

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11. TECHNICAL SPECIFICATIONS

11A Site Work
- 02005 Environmental Protection
- 02010 Maintenance of Traffic
- 02050 Demolition and Removal
- 02100 Razing and Alterations
- 02200 Earthwork
- 02201 Earthwork for Utilities and Structures
- 02203 Base Course for Roads and Driveways
- 02280 Soil Treatment
- 02600 Plant Mix Bituminous Pavement
- 02601 Bituminous Prime Coat
- 02713 Exterior Water Distribution System
- 02720 Storm Drainage System
- 02724 Oil Stop Valve
- 02831 Chain Link Fences

11B Concrete
- 03100 Concrete Formwork
- 03200 Concrete Reinforcement
- 03300 Cast-In-Place Concrete
- 03301 Grouting
- 03412 Precast Prestressed Concrete

11C Masonry
- 04230 Reinforced Unit Masonry
- 04812 Glass Masonry Assemblies

11D Metals
- 05500 Metal Fabrications
- 05501 Miscellaneous Metals

11E Thermal and Moisture Protection
- 07213 Batt Insulation
- 07540 Fluid Applied Roofing
- 07920 Sealants

11F Doors and Windows
- 08110 Steel Doors and Frames
- 08114 Standard Steel Doors
- 08115 Standard Steel Frames
- 08712 Finish Hardware

11G Finishes
- 09212 Plastering
- 09900 Painting

11H Special Construction
- 13283 Removal/Control and Disposal of Paint with Lead

11I Mechanical
- 15000 Mechanical General Requirements
- 15400 Interior Plumbing System
- 15500 Air Conditioning and Ventilation System

11J Electrical

16050 Basic Electrical Materials and Methods

11K Contractor Furnished Equipment

16052 Contractor-Furnished Equipment and Materials
16351 34.5 kV Metal-Clad Switchgear
16352 13.8 kV Metal-Clad Switchgear
16353 Disconnect Switch 34.5 kV
16354 Disconnect Switch 13.8 kV
16371 Insulators
16372 Surge Arresters
16373 Terminators 15 kV and 35 kV
16390 Grounding
16402 Interior Wiring Systems
16405 Station Batteries
16406 Battery Charger
16510 Lighting System
16704 Supervisory Control and Data Acquisition System
16802 Conductors
16803 35 kV 1000 kcmil AL Underground Conductor, Terminators, and Accessories
16804 15 kV 750 kcmil CU Underground Conductor, Terminator, and Accessories
16805 Stainless Steel Static Wire
16998 Installation Testing
16999 Energization and Start Up

11L Owner-Furnished Equipment and Materials

16051 Owner-Furnished Equipment and Materials
16355 Power Transformer 34.5/13.8 kV 30 MVA
16374 Concrete Pole

SECTION 02005

ENVIRONMENTAL PROTECTION

PART 1 - GENERAL

1.1 DEFINITIONS OF CONTAMINANTS

A. Sediment: Soil and other debris that has been eroded and transported by runoff water.

B. Solid Waste: Rubbish, debris, garbage, and other discarded materials resulting from industrial, commercial, and agricultural operations, and from community activities' such material having insufficient liquid content to be free flowing.

C. Rubbish: A variety of combustible and noncombustible wastes such as ashes, waste materials that result from construction or maintenance and repair work, leaves and tree trimmings.

D. Chemical Wastes: Includes salts, acids, alkalies, herbicides, pesticides, petroleum-derived products and organic chemicals.

E. Sewage: Water-carried waste products from residences, public buildings, institutions or other buildings, including excrementitious or other discharge from the bodies of human beings or animals, together with such ground water infiltration and surface water as may be present.

F. Garbage: Refuse and scraps resulting from preparation, cooling, dispensing, and consumption of food.

G. Asbestos and Asbestos Materials: Asbestos means actinolite, amosite, anthophyllite, chrysotile, crocidolite, and tremolite. Asbestos materials means asbestos or any material containing asbestos such as asbestos waste, scrap, debris, bags, containers, equipment, and asbestos-contaminated clothing consigned for disposal. Friable asbestos material requires a Waste Disposal Permit. Submit one (1) copy of Guam Environmental Protection Agency (GEPA) permit or license which reflects such agency's approval of the disposal plan as being in compliance with their waste disposal regulations.

H. Polychlorinated Biphenyl (PCB): PCBs were widely used as dielectric and coolant fluids in transformers, capacitors, and electric motors. Due to its toxicity and classification as a persistent organic pollutant, PCB production was banned by the United States Congress in 1979 and by Stockholm Convention on Persistent Organic Pollutants in 2001.

1.2 ENVIRONMENTAL PROTECTION REQUIREMENTS

A. Provide and maintain during the life of the contract, environmental protection as defined

herein. Provide environmental protective measures as required to control pollution that develops during normal construction practice.

B. Provide also environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the project. Comply with all federal and local statutes and regulations pertaining to environmental protection.

1.3 SUBMITTALS

A. Environmental protection Plan: Submit two (2) copies of the proposed Environmental Protection Plan (EPP) to the Guam Environmental Protection Agency (GEPA) and 2 copies to the Contracting Officer for review and approval no later than 10 calendar days after receipt of the Notice to Proceed (NTP) with work under this project. Review of the plan by the Contracting Officer and GEPA will be accomplished simultaneously.

The Contractor shall not undertake any clearing, grubbing, earthwork, and excavations until the EPP has been approved by the GEPA and the Contracting Officer.

B. Solid waste Disposal Permit: Submit one (1) copy of local permit or license which reflects Guam Environmental Protection Agency's (GEPA) approval of the disposal plan as being in compliance with their solid waste disposal regulations.

C. The Contractor must submit an approved Erosion Control Plan (ECP) to Guam EPA to be implemented and maintained throughout the duration of the project.

PART 2 - PRODUCT (None Required)

PART 3 - EXECUTION

3.1 PROTECTION OF NATURAL RESOURCES: The natural resources within the project boundaries and outside the limits of permanent work performed under this contract shall be preserved in their existing condition or restored to an equivalent or improved condition upon completion of the work. Confine construction activities to areas defined by the work schedule, drawings, and specifications.

A. Land Resources: Except in areas indicated to be cleared, do not remove, cut, deface, injure, or destroy trees or shrubs without special permission from the Contracting Officer.

1. Protection: Protect existing trees which are to remain and which may be injured, bruised, defaced, or otherwise damaged by construction operations. Remove displaced rocks from uncleared areas. Protect monuments, markers, and works of art.

B. Repair or Restoration: Repair or restore to their original condition all trees or other landscape features scarred or damaged by the equipment or operations. Obtain approval of the repair or

restoration from the Contracting Officer prior to its initiation.

C. Temporary Construction: At the conclusion of the project, obliterate all signs of temporary construction facilities such as work areas, stockpiles of excess or waste materials, and all other vestiges of construction.

D. Water Resources: Perform all work in such a manner that any adverse environmental impact on water resources is reduced to a level acceptable to the Contracting Officer.

E. Oily and Other Hazardous Substances: Take special measures to prevent oily or other hazardous substances from entering the ground, drainage areas, or local bodies of water.

3.2 CONTROL AND DISPOSAL OF SOLID, CHEMICAL, AND SANITARY WASTES: Pick up solid waste and place in containers which are emptied on a regular schedule. The preparation, cooking, and disposing of food are strictly prohibited on the project site. Conduct handling and disposal of waste to prevent contamination of the site and other areas. On completion, leave areas clean and natural looking. Remove signs of temporary construction and activities incidental to construction of the permanent work in place.

A. Disposal of Rubbish and Debris: Dispose of rubbish and debris in accordance with the requirements specified herein.

Remove rubbish and debris from the project site and dispose of it in compliance with federal and local requirements.

B. Garbage Disposal: Place garbage in appropriate containers and transport such refuse to an approved landfill for disposal at least once per week. As an alternative, the Contractor may arrange for weekly pickup and disposal service either with the Government of Guam or a privately-owned garbage collection service. The Contractor shall pay all fees associated with obtaining and maintaining garbage collection and disposal services.

C. Sewage, Odor, and Pest Control: Dispose of sewage through connection to the public sewage system. Where such system is not available, use chemical toilets or comparably effective units and periodically empty waste into the public sanitary sewage system. Include provisions for pest control and elimination of odors.

D. Chemical Waste: Store chemical waste in corrosion resistant containers labeled to identify type of waste and date filled. Remove containers from the project site, and dispose of chemical waste in accordance with federal, state, and local regulations. For oil and hazardous material spills which may be large enough to violate federal and local regulations, notify the Contracting Officer immediately and take measures as instructed by the Contracting Officer, at no additional costs.

E. Petroleum Products: Conduct fueling and lubricating of equipment and motor vehicles in a manner that affords the maximum protection against spills and evaporation. Dispose of

lubricants to be discarded and excess oil in accordance with approved procedures meeting federal and local regulations.

3.3 DUST CONTROL: Keep dust down at all times, including non-working hours, weekends, and holidays. Sprinkle or treat, with dust suppressors, the soil at the site, haul roads, and other areas disturbed by operations. No dry brooming is permitted. Instead use vacuuming, wet mopping, wet sweeping, or wet power brooming. Air blowing is permitted only for cleaning non-particulate debris, such as steel reinforcing bars. No sandblasting is permitted unless dust therefrom is confined. Only wet cutting of concrete blocks, concrete, and asphalt is permitted. No unnecessary shaking of bags is permitted where bagged cement, concrete mortar, and plaster is used.

3.4 NOISE: When available, make the maximum use of "low-noise emission products" as certified by Guam Environmental Protection Agency.

3.5 TESTING AND DISPOSAL OF CONTAMINATED SOIL

The Contractor shall perform soil test(s) on excavated materials for possible contamination with PCB. Testing and number of test(s) required shall be coordinated with the Contracting Officer and the Guam Environmental Protection Agency (GEPA).

If PCBs are found in excavated soils, the Contractor must dispose these soils in accordance with local and federal regulations.

END OF SECTION 02005

SECTION 02010

MAINTENANCE OF TRAFFIC

PART 1 - GENERAL

1.1 Traffic control and safety devices shall be in accordance with Part VI of the Manual on Uniform Traffic Control Devices (MUTCD) For Streets and Highways: U.S. Federal Administration, hereinafter referred to as "the Manual".

1.2 Prior to beginning work, the Contractor shall submit to Department of Public Works Traffic Engineering Section, proposed Traffic Control Plan and a "copy" furnished to the Contracting Officer. The Contractor shall also include a schedule listing of the types and number of traffic control and safety devices and requirements for flagmen proposed for use to be use in the project. Do not begin work until DPW has approved the Traffic Control Plan.

1.3 Unless otherwise approved or directed by the Contracting Officer, the minimum widths for one-lane and two-lane traffic shall be 10 feet and 20 feet, respectively.

PART 2 - PRODUCTS

2.1 TRAFFIC CONTROL DEVICES: Traffic control devices shall conform to the applicable specifications, standards and principles of the Manual except as amended herein. The traffic control devices shall be used at the site for construction, Contracting Officering survey, and related work that might endanger passing motorists, pedestrians and workers.

A. Traffic control devices shall be in place prior to the start of any construction, maintenance, Contracting Officering survey, and related work and shall be removed until the obstruction or danger of obstruction no longer exists. Where work is performed in stages, there shall be in place those devices that apply to the conditions and activities present during the stage in progress.

B. All signs, markers, barricades, cones, lights, and other devices indicating the existence of special conditions and activities shall remain in place until their need is no longer required, unless otherwise directed by the Contracting Officer. Signs that do not apply to existing conditions and activities shall be removed or covered. All devices employed shall be neatly constructed and shall be repaired, cleaned, repainted, and properly maintained in good condition. Special care shall be taken to see that shrubbery, construction materials, equipment, spoil and other obstructions do not obscure any sign, light or barricade, particularly at intersections or curves.

C. When it becomes necessary to excavate along or across a highway or any lane thereof, the work shall be performed to avoid existing local peak traffic hours.

2.2 SIGNS:

A. Regulatory signs, warning signs and guide signs used at construction, surveying or other sites shall be reflectorized and shall conform to the basic standards prescribed in the Manual and as specified in the applicable Sections of the Specifications. Generally, signs shall be placed in the most effective locations so as to assure the fastest and most adequate driver response time. All advance warning signs shall be placed on each approach and shall indicate the general character of the work being done, and the distance from the sign to the actual work area.

B. The Contracting Officer may waive any requirements specified herein if advance application is made by the Contractor when in his judgment, the placement of signs may not be feasible or such placement may interfere with the progress of the work.

2.3 BARRIERS AND CHANNELIZING DEVICES:

A. Barriers and channelizing devices used at work sites shall follow the basic standards prescribed in the Manual and the following provisions.

B. When it is necessary to confine the traffic to singular lanes, additional transverse barricades and drums shall be placed at close intervals (approximately 120-foot spacing on tangents and curves of more than 500 feet radius and approximately 60-foot spacing on curves of 500 feet radius or less) in the closed lane.

C. Where hazardous locations occur, a series of Type II barricades, cones or drums shall be placed in longitudinal rows along the edge of the closed area (continuously for barricades and at approximately 15-foot spacing for cones and drums).

PART 3 - EXECUTION

3.1 Maintaining Traffic: The Contractor shall conduct construction operations with minimum interference to traffic on roads, streets and driveways and he shall have under construction, no greater length or amount of work than he can prosecute properly with due regard to the rights of the public. Roads, streets and driveways shall be kept free of dirt and debris at all times. Convenient access to driveways, houses and buildings along the line of the work shall be maintained. In all areas, the Contractor shall install and maintain appropriate signs, lights, flares and barricades for the protection of the public. Such signs and barricades and their placement shall conform to instructions contained in Part VI of the "Manual on Uniform Traffic Control Devices for Streets and Highways". The Contractor is expected to be familiar with all applicable Government of Guam laws and compliance with such laws is considered a part of this contract.

3.2 Coordination:

A. In the case of conflict between the Manual and the specifications the most stringent requirements shall apply.

B. This Section of the specifications shall be coordinated with all related documents affecting the work.

C. All work shall be coordinated through the Contracting Officer.

END OF SECTION 02010

SECTION 02050

DEMOLITION AND REMOVAL

PART 1 - GENERAL

1.1 PROCEDURES: Areas in which demolition and removal is to be accomplished shall be as indicated on the drawings, either specifically or as necessary or incidental part of the work. The procedures shall provide for the safe conduct of the work, careful removal and disposition of materials to be removed, protection of property which is to remain undisturbed and coordination with other work involved.

1.2 EXPLOSIVES: Use of explosives will not be permitted.

1.3 PROTECTION OF EXISTING STRUCTURES, UTILITIES AND OTHER ITEMS OF PROPERTIES: Existing structures, utilities, and other items of properties to remain shall be protected from damage during demolition and removal operation. Any damage to existing facilities, structures, utilities or other works shall be repaired by the Contractor, using materials equal to or better than those existing, all at the Contractor's expense.

In addition, the Contractor shall seek and obtain written clearances from U.S. Navy PWC and utility agencies of the Government of Guam, specifically DPW, GTA, GWA, GPA, etc. prior to undertaking demolition/removal operations. As part of obtaining such clearances, the Contractor shall specifically request each utility agency to stake out the location of their utilities prior to undertaking any demolition or removal work.

PART 2 - PRODUCTS (None required)

PART 3 - EXECUTION

3.1 DEMOLITION:

1. The work includes the removal of concrete foundations, pavements, fencing, piping and other items as indicated on the drawings, or as required to accomplish the work. Miscellaneous items that will be a hindrance or hazardous to the work to be done shall be removed and disposed of, as directed by the Engineer.

2. Dust and Noise Control: The amount of dust resulting from demolition shall be controlled to prevent the spread of dust to occupied portions of the area and to avoid creation of a nuisance in surrounding areas. Use of water will not be permitted when it will result in, or

create, hazardous or objectionable conditions such as flooding, or pollution. Noise associated with the demolition shall be controlled by proper selection of the equipment used, procedure selected, time of day, or day of the week the work is accomplished, to minimize adverse effects of the necessary noise on the every-day operations or activities of the Contractor.

3.2 SALVAGE AND DISPOSAL:

1. Salvage: The Contractor shall remove existing facilities as necessary or as indicated; salvage usable materials as directed; store, transport, stockpile and/or protect it at the location designated by the Engineer. All salvaged materials shall be the property of the Owner.

2. Disposition: Refuse resulting from demolition operations shall be hauled at the Contractor's expense to an approved disposal site by the Contractor and shall be disposed of at the Contractor's expense in such a manner as to meet all applicable requirements, regulations and laws of the Government of Guam regarding environmental protection, health, safety and public welfare. The Contractor may not dispose of such refuse by burning on the site of the project at any time.

   In no case shall any material be left on the project, shoved onto abutting properties or areas, or be burned in embankments or trenches on the project. Demolition and removal/disposal operations shall be carried out well in advance of construction operations so as to permit a well-planned schedule of work.

3.3 CLEANUP: Upon completion of demolition and removal operations, the entire area shall be cleaned of all debris and rubbish in a manner satisfactory to the Engineer.

END OF SECTION 02050

SECTION 02100

RAZING AND ALTERATIONS

2A.1 GENERAL. This section covers razing, removal, and alteration of existing structures and materials as required to complete the structural work specified herein and indicated on the drawings.

Structures and material to be razed or modified shall include the existing structures and materials described below and as indicated on the contract drawings.

Remove existing chain link fence and existing gates.

Remove existing steel structures.

Remove existing three-phase 34.5 kV disconnect switch from the box structure.

Remove existing 34.5 kV bus work associated with the power transformer.

Remove power transformer and associated equipment/ materials from the 34.5 kV main bus connection point and up to the 13.8 kV switchgear.

The above listings are intended to give a general definition of the extent of razing work to be performed and shall not be construed as an itemized listing of each item to be razed.

Materials shall be removed within the designated areas indicated on the drawings. Materials shall be removed at least flush with or beyond the limits indicated. The repair of existing surfaces remaining after material and equipment removal will be required, as specified on the drawings or in these specifications.
All excavations made by grubbing or removal of existing structures and facilities shall be backfilled with compacted earth.

Before clearing work is accepted, any regrowth of vegetation or tree shoots shall be cut and removed. Tree shoots shall be removed to the level specified for tree removal in that area. All regrowth of vegetation shall be mowed, raked, and removed from the site and disposed of in accordance with the requirements of the regulatory authorities having jurisdiction.

All electrical equipment, materials, wire, conduit, and miscellaneous items as directed by the Owner shall be salvaged for reuse or turned over to the Owner for future use. Such materials or equipment shall be removed using due care to prevent damage to them.

2A.2 CONDITIONS OF STRUCTURES. The drawings indicate the assumed locations of various types of existing construction but the Owner does not guarantee this data. The full extent and nature of the work and the location and condition of the materials to be razed or modified shall be determined by a thorough inspection of the site and review of drawings.

The Contractor shall verify at the site all dimensions that relate to the work and shall report any discrepancies to the Owner.

2A.3 PROTECTION. The Contractor shall not interrupt existing utilities except when authorized by the Owner. Temporary services shall be provided during interruptions of service.

The Contractor shall comply with any utility requirements when excavating near existing utilities.

The Contractor shall protect from damage all existing structures, utilities, and equipment which are to remain in place. Special precautions shall be employed to minimize the possibility of damage to the existing equipment. The Contractor shall repair all damages resulting from his work and pay all associated costs. In addition to protection of structures and equipment, special attention shall be directed to the safety and protection of plant operating personnel and construction personnel engaged on the premises.

Special attention shall be given to dust control during concrete removal operations. Dust shall be controlled by means of water spray, vacuum cleaners, or other methods acceptable to the Owner.

In areas where welding or flame cutting will be used, special attention shall be given to fire protection. All areas shall be dust free before flame cutting will be permitted. Flame resistant blankets shall be provided to protect combustible materials and finished surfaces. Dry chemical fire extinguishers shall be provided in such areas and workmen shall be trained in their use.

2A.4 RAZING. Methods used in razing shall be in accordance with all codes, ordinances, and requirements of the governing authority; shall be approved by the Owner and shall in all cases assure the safety of persons, properties, and existing structures.

2A.5 FOUNDATION AND CONCRETE MODIFICATIONS. Existing foundations shall be removed as indicated on the drawings, specified herein, or directed by the Owner. Removal shall include but not be limited to removal of piles just below the existing concrete cap, and removal of the reinforced concrete pile cap and pedestal.

The removal of concrete shall be planned and executed so the work can proceed without delay and with a minimum of vibration, dust, and rubble.

All razed concrete and other debris in connection with the razing and alterations shall be removed from the site as specified in these specifications.

After removing the below grade razed concrete, the area shall be backfilled with suitable material and procedures as specified in these specifications.

2A.6 STRUCTURAL AND MISCELLANEOUS METAL MODIFICATIONS. These general requirements shall govern all structural steel and miscellaneous metal removal and modifications insofar as they apply.

Razed metal materials shall be reused only if indicated on the drawings or specified herein. Materials not designated or specified to be reused shall be disposed of as specified in these specifications.

Except as otherwise indicated, steel framing designated to be removed shall be disconnected and removed without impairing the stability of the remaining structure and without damage to the remaining members and connections. To the extent practicable, steel framing shall be removed by the disassembling of bolted connections. Connection rivets shall be drilled or otherwise removed in a manner that will not damage holes to be reused. Flame cutting of rivets in holes to be reused will not be acceptable.

2A.7 SURFACING MODIFICATIONS. All existing crushed rock surfacing required to be removed for construction operations shall be stockpiled and reused in the base course for resurfacing the disturbed area or in the base course for surfacing the new substation area. The top course for resurfacing disturbed areas shall consist of new materials and shall be finished flush with adjacent undisturbed materials. Surfacing materials and application methods shall be as specified in these specifications.

2A.8 SALVAGE AND RUBBISH. Except for the materials or equipment listed in the detailed specification or indicated on the drawings to be retained, all removed materials, debris, and rubbish resulting from razing operations shall be promptly removed from the site and disposed of in accordance with the requirements of the regulatory authorities having jurisdiction.

2A.9 CLEANUP. At the completion of razing work, the entire demolition area shall be cleaned of all debris and rubbish. In addition, all interior areas shall be free of settled dust, mortar, plaster, or other contaminants.

END OF SECTION 02100

SECTION 02200

EARTHWORK

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: The latest issues of the publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1. American Society for Testing and Materials:

C 136 Method Sieve Analysis of Fine and Coarse Aggregates

D 1140 Test Method for Amount of Material in Soils Finer than the No. 200 (75 micrometer) Sieve

D 1556 Test Method for Density of Soil in Place by the Sand Cone Method

D 1557 Test Method for Moisture Density Relations of Soils and Soil Aggregate Mixtures Using 10-lb. (4.54kg) Rammer and 18-in (457-mm) Drop

D 2419 Test Method for Sand Equivalent Value of Soils and Fine Aggregate

D 2487 Test Method for Classification of Soils for Engineering Purposes

D 2922 Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

D 3017 Test Method for Water Content of Soil and Rock In Place by Nuclear Methods (Shallow Depth)

D 4318 Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils

B. Army Corps of Engineers Publications:

Army Corps of Engineers Manual EM-385-1-1

1.2 DESCRIPTION OF WORK: This Section covers all earthwork required for driveways, including structure excavation, subgrade preparation, site grading, and backfilling. In addition, this Section

covers all earthwork required for restoration of damaged existing roads and driveways.

The Contractor shall provide the services of a competent, licensed land surveyor to establish all lines, levels, grades, bench marks and measurements required to lay out the work and further shall be responsible for the correctness and accuracy of such work.

1.3 SUBMITTALS:

A. Certified Test Reports: Submit certified test reports before starting work for the following:

Fill, backfill, bedding tested in accordance with ASTM C136 and ASTM D2487.

1.4 DELIVERY AND STORAGE: Deliver and store materials in a manner to prevent contamination or segregation.

1.5 SOIL BORING LOGS AND SUBSURFACE INVESTIGATIONS: There are no soil report and subsurface information for this project. The Contractor shall be fully responsible for making his own investigations of the actual field conditions prior to bidding. The submission of a proposal shall be prime evidence that the bidder has made such investigations.

1.6 CRITERIA FOR BIDDING AND PREVAILING WORK CONDITIONS: Base bids on the following criteria and be fully prepared to work under the following prevailing conditions:

A. Surface elevations are approximately as indicated.

B. Pipes, cables and/or other artificial obstructions in addition to those indicated will likely be encountered.

C. Abandoned pipes or other artificial obstructions encountered are to be demolished and removed at the direction of the Contracting Officer.

D. Hard material in the form of concrete foundations, asphaltic-concrete pavement and coral rock will be encountered. Hard material is defined as solid rock, firmly cemented unstratified masses, or conglomerate deposits possessing the characteristics of solid rock which can not ordinarily be removed without systematic drilling and blasting or use of special high impact rock-breaking equipment, and any boulder, masonry, or concrete except slabs, pavement, curbs and foundations, exceeding ½-cubic yard in volume.

E. All earthwork is unclassified and that no special or additional compensation will be made for any class of excavation whatsoever, regardless of the type of material or quantity encountered. No extra compensation will be made by reason of any misunderstanding or

error on the part of the Contractor with regards to the site, the conditions thereof or the amount and kind of earthwork to be performed.

1.7 PROTECTION OF EXISTING FACILITIES: Existing utilities and construction shall be protected from damage during earthwork operations. The Contractor shall seek and obtain written clearances from Navy PWC, and utility agencies of the Government of Guam, specifically DPW, GTA, GPA, GWA, etc. prior to undertaking any earthwork operations. As part of obtaining such clearances, the Contractor shall specifically request each utility agency to stake out the location of their utilities prior to undertaking any excavation or filling work. In addition, the Contractor shall obtain and use as reference as-built drawings of existing utilities from all utility agencies, if available. Any damages to existing facilities, public or private, shall be promptly repaired by the Contractor at no cost to the Owner. Damages to existing facilities, structures, utilities or other works shall be repaired by the Contractor, using materials equal to or better than those existing, all at the Contractor's expense.

When directed by the Engineer, excavation near or around known utilities shall be by careful hand excavation. Hand excavation shall start at a reasonable distance from each side of the indicated obstruction and shall be continued until the obstruction is uncovered or until clearance for the new line is assured. The Contractor shall properly support all uncovered lines or other existing work as affected by the contract excavation.

Report to the Engineer any condition found which is not indicated on or anticipated by the drawings and specifications and do not proceed with work in the affected area until a decision is rendered.

1.8 SAFETY REQUIREMENTS: Work on this project shall comply with OSHA requirements.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS: In general, soil materials shall be free of debris, roots, wood scrap material, vegetable matter, refuse, soft unsound particles, deleterious, or objectionable materials.

A. General Fill: Shall conform to the general requirements for soil materials and shall meet the following requirements:

1. Liquid Limit (minus #40 mesh material): Not more than 40.

2. Plasticity Index: Not more than 15.

3. Material passing No. 200 mesh sieve: 30 percent maximum.

4. Maximum particle size (in any dimension): 3 inches

B. Crushed Rocks: Crushed rocks shall consist of washed crushed coral rock, in pieces varying from 1/2 inch to 2 inches in any dimension. The crushed rocks shall be placed in layers not exceeding 18" (loose thickness) and compacted until it is dense and non-yielding. No compaction test required.

C. Pipe Envelope & Bedding Material: Bedding and envelope material for pipes shall conform to any one of the following materials:

1 Manufactured sand free of organic substances and/or rubbish. Mining of beach sand is not permitted on the island of Guam. When tested in accordance with ASTM C136, the material shall conform to the following gradation limits.

Sieve Size	Percent Passing
3/8 inch	100
No. 4	85 - 100
No. 16	45 - 80
No. 50	10 - 30
No. 100	0 - 10
No. 200	0 - 5

Where groundwater is encountered in excavation, bedding material shall be crushed rock per Subparagraph 2.1(B) of this Section.

D. Trench Backfill: Backfill for trenches shall meet the requirements of general fill as specified in Subparagraph 2.1(A) of this Section, except above subgrade level for paved areas where backfill shall be subbase and/or base course to the dimensions defined on the drawings.

E. Aggregate Base Course: Refer to Section 02203, entitled Base Course for Roads and Driveways.

F. Granular Fill: Granular fill shall meet the requirements of Paragraph 2.1E, except that the material shall be 1-inch minus.

G. Unsuitable Materials: In general, unsuitable materials consist of soft soils which cannot meet the compaction requirements after reconditioning by approved methods, and of other objectionable materials.

H. Material Sources: The Contractor shall be responsible for procuring materials from sources approved by the Engineer. Unless otherwise indicated by the drawings, all borrow or imported materials for earthwork shall be obtained from designated or off-site approved sources. Materials shall be selected, mixed and or blended thoroughly to conform to the required specifications for each class of material and stored in stockpiles which are segregated from other materials. Representative samples of each stockpile must be taken by the Independent Laboratory employed by the Contractor in the presence of the Engineer or his authorized representative. No material shall be used in the work or placed in any other location on the project site without the written approval of the Engineer.

All clearing, grubbing, quarrying, crushing, hauling, mixing or blending and other work related or incidental to the importation or processing of materials shall be at the Contractor's expense.

PART 3 - EXECUTION

3.1 GENERAL:

A. Demolition and Removal: Shall be as specified in Section 02050, entitled Demolition and Removal.

B. Removal of Unsuitable Material: Remove soil, muck, rubbish, debris and other unsuitable materials at and under areas designated for construction.

C. Excavation: This work shall consist of excavation, disposal and/or compaction of all materials of whatever character encountered within the limits of the work and which is necessary for the construction of improvements in accordance with the grades, thicknesses and typical cross sections shown on the drawings or established by the Engineer. Suitable materials removed from the excavation may be used as far as practicable in the formation of embankment, subgrade, bedding, and backfill for structures and pipes, and for other purposes shown on the drawings or as directed or approved by the Engineer.

D. Filling: Filling in areas indicated on the drawings shall consist of placing and compacting of approved material on approved subgrade, including the placing and compacting of fill material in areas where unsuitable materials have been removed, holes, pits, and other depressions within the project area.

E. Dewatering: Include in dewatering the collection and disposal of all forms of surface and subsurface water that may be encountered in the course of construction. This shall include the complete and continuous dewatering of all excavations until backfilled. Dewatering of structure excavations shall be such that groundwater is lowered to at least 2 feet below the excavated subgrade and subgrade soils are not softened or disturbed. All dewatering activities including disposal of groundwater shall be done in conformance with all applicable regulations. A permit application and dewatering plan must be submitted to Guam EPA for review and approval.

3.2 REQUIREMENTS FOR GRADING:

A. Preparation for Grading: Prior to beginning excavation, grading, and filling work in any area, perform all necessary demolition and removal and clearing and grubbing work in that area in accordance with Section 02050, “Demolition and Removal”.

Where filling below subgrade is to be made, all sod and vegetable matter and unsuitable materials shall be removed from the surface upon which the fill is to be placed, and the cleared surface shall be completely broken up by plowing, scarifying, or stripping to a minimum depth of 6 inches but not more than 2 feet, and compacted in accordance with Subparagraph 3.2. (G) of this Section.

B. Utilization of Excavated Materials: All suitable material removed from excavation shall be used, as far as practicable, in the formation of the embankment, filling, subgrade, and backfill for structures, and for other purposes shown on the drawings or as directed. Only approved materials shall be used in the construction of embankments and backfills. (The Engineer shall designate as unsuitable those soils that cannot be properly compacted.) All unsuitable materials shall be properly disposed of at the Contractor's expense at designated and/or approved disposal areas. All excess materials, including rock and boulders that cannot be used in fill areas shall be disposed of as directed by the Engineer on or off the project site at the Contractor's expense. Material encountered in the excavation and determined by the Engineer as suitable for topping or fill, or other purposes shall be conserved and utilized as directed.

C. Drainage Ditches and Swales: If any drainage ditches and swales required or to be restored after construction shall conform to the slope, grade, and shape of the required cross-section, with no projections of roots, stumps, rock or similar matter. The Contractor shall maintain and keep open and free from leaves, sticks, and other debris all ditches dug by him until final acceptance of the work.

D. Removal of Unsuitable Materials: The Contractor shall not excavate beyond the dimensions and elevations established, except where unsuitable materials are

encountered in the subgrade. Where unsuitable materials are encountered, such materials shall be removed to a depth required to obtain a dense, unyielding subgrade as determined by the Engineer. The excavation shall then be backfilled with general fill compacted as required in this Section. If the bottom of excavation is too soft for placing compacted general fill, crushed rock shall be used for backfill in lieu of general fill but limit the crushed rock thickness to only required to stabilize soft soil.

Crushed rock backfill shall be spread uniformly without segregation. The upper surface of the crushed rock shall be compacted until it is dense and non-yielding. This work shall be a basic responsibility of the Contractor and shall be accomplished at no additional cost to the Owner.

E. Placing General Fill: Unless otherwise permitted by the Engineer, fills and backfills shall not contain mulch, roots, sod, or other deleterious matter.

Fill material shall be placed in horizontal layers not exceeding 10 inches (loose measurement) and shall be compacted as specified before the next layer is placed, except as otherwise directed by the Engineer. Effective spreading equipment shall be used on each lift to obtain uniform thickness prior to compacting. As the compaction of each layer progresses, continuous leveling and manipulating will be required to assure uniform density. Water shall be added or removed, if necessary, in order to obtain the required density.

Removal of water shall be accomplished through aeration by plowing, blading, disking, or other methods satisfactory to the Engineer. Hauling equipment shall be dispersed uniformly over the entire surface of the previously constructed layer to minimize rutting or uneven compaction.

F. Placing Base Course and Granular Fill: Base Course and Granular Fill material shall be placed in horizontal layers not exceeding 8 inches (loose measurement) and shall be compacted as specified before the next layer is placed, except as otherwise directed by the Engineer. Effective spreading equipment shall be used on each lift to obtain uniform thickness prior to compacting. As the compaction of each layer progresses, continuous leveling and manipulating will be required to assure uniform density. Water shall be added or removed, if necessary, in order to obtain the required density. Removal of water shall be accomplished through aeration by plowing, blading, disking, or other methods satisfactory to the Engineers. Hauling equipment shall be dispersed uniformly over the entire surface of the previously constructed layer to minimize rutting or uneven compaction.

F. Compaction: Unless otherwise indicated on the drawings or in the other sections of these

specifications, the Contractor shall compact the material placed in all general fill layers, subgrade and the material scarified to the designated depth below subgrade in cut sections, until a uniform density of not less than 95 percent of the maximum determined by ASTM D1557, Method D.

3.3 EARTHWORK FOR STRUCTURES:

A. Description: This work shall consist of the necessary excavating and backfilling for foundations and structures in reasonably close conformity with the drawings or as established by the Engineer. This work shall also include necessary dewatering as well as the furnishing of equipment and materials thereto and their subsequent removal.

B. Excavation Requirements - All Structures: Trenches or foundation pits for structures or structure footings shall be excavated to the lines and grades or elevations shown on the drawings. They shall be of sufficient size to permit the placing of structures or structure footings of the full width and length shown. The elevations of the bottoms of footings, if shown on the drawings, shall be considered as approximate only, but, in fact, the actual dimensions or elevations of footings shall be those deemed necessary by the Engineer to permit the placement of base or bedding material as indicated on the drawings or to otherwise secure a satisfactory foundation. Boulders, logs, and any other objectionable material encountered in excavation shall be removed. After each excavation is completed, the Contractor shall notify the Engineer to that effect, and no backfill, base course, structure footing or any part of the structure shall be placed until the Engineer and the Owner’s Geotechnical Consultant has approved the depth of excavation and the character of the foundation material.

In excavations for footings carried below the depths indicated without specific directions from the Engineer, the additional depths shall be backfilled with lean concrete or other approved materials, or the footing shall be extended to the bottom of the excavations; all additional work of this nature shall be at the Contractor's expense. All foundation excavations shall be cleaned of all loose materials and cut to a firm surface. All loose and disintegrated rock and thin strata shall be removed.
When the foundation material is soft or mucky or otherwise unsuitable, as determined by the Engineer, the Contractor shall remove the unsuitable material as provided for in Subparagraph 3.2(D) of this Section. Where foundation subgrade for structures consists of clay or silt, the subgrade shall be excavated to provide for 24 inches of granular fill under all slabs and footings. The Contractor shall protect such sub-grades for disturbance and softening. When structure sub-grades consist of limestone or limestone gravel, 6 inches of granular fill shall be provided. All granular fills shall extend 3 feet beyond structure limits. The granular fill, as noted on the drawings, shall be placed and compacted in 8-inch layers up to the foundation elevation.

Excavations shall be shored and sheeted with members of sizes and arrangement sufficient to prevent injury to persons, damage to structure, injurious caving, or erosion. Shoring, sheeting, and bracing shall be removed as the excavations are backfilled; care shall be exercised to prevent injurious caving during the removal of the shoring and/or sheeting.

C. Utilization of Excavated Materials: All excavated materials, so far as suitable, shall be utilized as fill and/or backfill. Silty or clayey materials shall not be used for backfill under structures or immediately adjacent to. The surplus material shall not be placed within a drainage area, but shall be stockpiled or disposed of finally as directed by the Engineer and in such manner as not to obstruct drainage, or otherwise impair the efficiency or appearance of the structure. No excavated material shall be deposited at any time so as to endanger the partly finished structure.

D. Backfill for/Fill against Structures: Backfill for or fill against structures shall be placed simultaneously on both sides of the structure, except where conditions require that backfill or embankment is to be placed on only one side or be higher on one side. In such circumstances, backfill shall be placed only with the permission of the Engineer or after the structure has attained sufficient strength. All backfill and embankments adjacent to structures shall be placed in horizontal layers having an 8-inch maximum loose thickness, then compacted as specified herein. Backfill placed directly within 3 feet against structures shall consist of clean, free draining crushed limestone, crushed coral, rock, gravel or concrete coarse aggregate (½" min. to 1" maximum). Backfill within 2 feet of finished grade shall be impervious clayey silt compacted to 90 percent, ASTM 1557.

E. Compaction: If the limits of backfill are within the zone of a road subbase, a pavement structure, or immediately beneath foundations as defined on the drawings, backfill shall conform to the material and compaction requirements for base course (95% compaction) as specified in Subparagraph 3.2(G) of this Section. Compact other backfill adjacent to and not supporting any structural elements to at least 95% as determined by ASTM D1557 (Method D).

F. Grading Adjacent to Structures: The Contractor shall perform all grading in the areas so indicated. Fill shall be brought to finish grades indicated within 1/10 of a foot and shall be graded to drain water away from structures. Existing grades which are to remain and which are disturbed by the Contractor's operations shall be graded to provide surfaces suitable for the proper use of mowing machines.
Grades in areas to receive topsoil shall be brought to acceptable elevation.

G. Disposition of Surplus and Unsuitable Material: Surplus material not required for filling,

backfilling, or grading and other soil material shall be deposited in areas designated by the Engineer or hauled off the project site at the Contractor's expense to approved disposal areas. Wasted material shall be spread and leveled at the disposal area(s) to a degree which is satisfactory to the Engineer.

H. Subgrade Preparation: After site stripping and the required excavations are completed, the areas to be filled and the exposed surface of the completed excavated areas should be scarified to a depth of approximately 8 inches, moisture conditioned as necessary and recompacted to at least 90 percent compaction for clayey silt and 95 percent compaction for silty sandy gravel soil.

3.4 RESTORATION: All disturbed work, including grassing, plantings, pavements, etc., shall be restored to their original condition or better. Replacement materials shall be subject to the approval of the Engineer.

All remaining work that will be exposed shall have all damaged unfinished areas, or defects caused by the removal and preparatory work completely repaired, patched or filled in as required to match the adjoining existing surfaces. Where the method of repair work is not indicated or specified, the Contractor shall perform the repair work in accordance with the best recognized workmanlike procedure for the area and the surrounding construction involved, subject to the approval of the Engineer.

3.5 FIELD SAMPLING AND TESTING:

A. Samples: Submit one 50-pound composite sample for fill or backfill material taken from one source or from excavated materials of a similar, uniform character. Samples in the number directed, shall be submitted whenever the source or character of the material changes. Where imported material is used, a sample shall be taken which is representative of each source. Samples shall be placed in a clean container which shall be fastened to prevent loss of material and tagged for identification. The tag shall contain the following information:

Contract No.:	Source:
Sample No.:	Intended Use:
Date of Sample:	Sampler:

B. Tests: Fill, backfill and bedding shall be tested in accordance with ASTM C136 and for conformance to ASTM D2419, and ASTM D2487 gradation limits. Test fill and backfill for material finer than the No. 200 sieve in accordance with ASTM D1140. Test fill and

backfill for liquid limit and plasticity index in accordance with ASTM D4318. Test fill and backfill materials for moisture density relations in accordance with ASTM D1557 Method D. Perform one of each of the required tests for each material used when directed by the Engineer. Provide additional tests as specified above for each source change. Perform density tests in randomly selected locations and in accordance with ASTM D1556 or ASTM D2922 as follows: one test per 2,000 square feet in each layer of lift on fill areas or per 2,000 square feet of subgrade area in cut; one test per layer of lift per 500 linear feet of utility trench, or per utility trench section, whichever is less.

Determine moisture content of soil material in place in accordance with ASTM D3017 as follows: one test per 2,000 square feet in each layer of lift at fill areas or one test per layer of lift per 500 linear feet of utility trench, or per utility trench section, whichever is less.

A change in testing frequency or other requirements may be effected only upon the written approval of the Engineer.

END OF SECTION 02200

SECTION 02201

EARTHWORK FOR UTILITIES AND STRUCTURES

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS

The latest issues of the following publications of the listed below are referred to thereafter by basic designation only, for a part of this specification to the extent indicated by references thereto.

1. American Society for Testing and Materials (ASTM) Publications:

   C136 Method for Sieve Analysis of Fine and Coarse Aggregates.

   D1556 Test Method for Density of Soil in Place by the Sand-Cone Method.

   D1557 Moisture-Density Relations of Soils Using 10-lb. Rammer and 18 in. Drop.

   D2922 Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

1.2 QUALITY CONTROL

The Quality Control provisions apply to this section. All approvals, except those required for field installations, field applications, and field tests shall be obtained before construction is started and before delivery materials or equipment to the project site.

1.3 DESCRIPTION OF WORK

This Section covers all earthwork required for construction of storm drainage and utilities systems, including structure excavation, subgrade preparation, site grading and backfilling.

1.4 SUBMITTALS

1. Certified Test Reports: Before delivery of materials and equipment, four certified copies of the reports of all tests required in referenced publications or specified herein shall be submitted and approved. The testing shall have been performed in a laboratory meeting the requirements specified. The testing shall have been performed within three years of submittal of the reports for approval. Test reports shall be accompanied by notarized

certificates from the manufacturer certifying that the tested material and equipment is of the same type, quality manufacture, and make as that proposed to be supplied.

2. Dewatering Plan: Before commencing earthwork operation, four copies of the proposed dewatering plan shall be submitted to and approved by the Engineer. Dewatering plan shall include provisions for the control of all forms of surface and subsurface water that may be encountered in the course of construction.

1.5 DELIVERY AND STORAGE

Materials shall be delivered to and stored at the site in a manner which will maintain different materials in segregated piles and preclude the introduction of deleterious materials.

1.6 PROTECTION

1. Environmental Protection: All work and Contractor operations shall comply with the requirements of the Environmental Protection.

2. Protection of Utility Lines: Existing utility lines that are indicated or the locations of which are made known to the Contractor prior to excavating and trenching and that are to be retained, as well as utility lines constructed during excavating and trenching operations, shall be protected from damage during excavating, trenching and backfilling, and if damaged, shall be repaired as directed by the Engineer at the Contractor's expense. When utility lines that are to be removed are encountered within the area of operations, the Contractor shall issue written notification 48 hours in advance to the Engineer stating the necessary measures to be taken to prevent interruption of the service. The Contractor shall also make arrangements with appropriate utility agencies in accordance with their requirements for all utility work under this contract.

3. Shoring and Sheeting: Excavations shall be shored and sheeted with members of sizes and arrangement sufficient to prevent injury to persons, damage to structure, injurious caving, or erosion. Shoring, sheeting and bracing shall be removed as the excavations are backfilled; care shall be exercised to prevent injurious caving during the removal of the shoring and sheeting.

4. Blasting: Use of explosives will not be permitted.

1.7 CRITERIA FOR BIDDING

The Contractor shall base his/her bid based on the criteria and prevailing work conditions outlined in Paragraph 1.6 of Section 02200, entitled Earthwork.

PART 2 - PRODUCTS

2.1 MATERIALS

1. Bedding Material: Refer to Paragraph 2.1C of Section 02200.

2. General Fill: Refer to Paragraph 2.1A of Section 02200.

3. Select Fill: Material for select fill shall be coral or basalt, free of objectionable materials and of fragments larger than 3 inches in any dimension. Material shall meet the following requirements:

Sieve Size	Percent Passing by Weight
3 inches	100
No. 4	10 - 100
No. 200	8 - 25

Liquid Limit = 25 maximum
Plasticity Index = 6 maximum

4. Crushed Rocks: Refer to Paragraph 2.1B of Section 02200.

2.2 TOPSOIL

Material from the areas to be excavated or graded which are suitable for topsoil, shall be deposited in piles separate from other excavated material. Piles of topsoil shall be located so that the material can be used readily for the finished surface grading: topsoil shall be protected and maintained until needed. Any surplus of topsoil shall be stockpiled as directed by the Engineer. When used for finished surface grading, topsoil shall be spread uniformly over the areas indicated.

PART 3 - EXECUTION

3.1 EXCAVATING, BACKFILLING, AND GRADING

1. General: Excavations shall be carried to contours and dimensions indicated or necessary. Excavations shall be kept free from water while construction is in progress. The bottom of the trench excavation shall be compacted to 90 percent ASTM D1557, Method D, density. Soft soil or unsuitable material encountered at bottom of excavation

shall be removed to the depth necessary to obtain the required density but not exceeding 24 inches. The excavation shall then be backfilled with general or select fill compacted to 95 percent. If the bottom of excavation is too soft for placing compacted general or select fill, crushed rock shall be used for backfill in lieu of general or select fill. Crushed rock backfill shall be spread uniformly without segregation. The upper surface of the crushed rock shall be compacted with a vibratory compactor until it is dense and non-yielding. All additional work of this nature shall be at the Contractor's expense.

2. Grading: The Contractor shall perform all grading in the areas so indicated. Fill shall be brought to finished grades indicated within a one-tenth of a foot and shall be graded to drain water away from structures. Existing grades which are to remain and which are disturbed by the Contractor's operations shall be graded to provide surfaces suitable for the proper use of mowing machines. Grades under areas to receive topsoil shall be brought to acceptable elevation.

3. Disposition of Surplus Material: Surplus material not required for filling, backfilling, or grading and other material shall be wasted by disposition in the area indicated or hauled at the Contractor's expense to an approved disposal site in compliance with federal and local requirements.

3.2 DEWATERING

1. Dewatering During Construction: Dewatering shall include the control of all forms of surface and subsurface water that may be encountered in the course of construction.

3.3 FIELD SAMPLING AND TESTING

a. Sampling: All sampling shall be conducted by the Contractor at his expense. A 50-lb. sample of bedding material shall be taken at every 500 cubic yards for sieve analysis of aggregate. Duplicate samples shall be provided to the Engineer on an average of one (1) sample a month. The duplicate samples shall be taken at the same time and in the same manner, and shall bear the sample number of identification.

2. Sample Identification: Each sample shall be contained in a clean container which shall be securely fastened to prevent loss of material. Each sample shall be tagged for identification. The tag shall contain the following information:

Contract No.: _____
Sample No.: _____ Quantity: _____
Date of Sample: _____
Sampler: _____

Source: _____
Intended Use: _____
For Testing: _____

3. Testing: All testing shall be conducted by the Contractor as specified herein at the expense of the Contractor.

    1. Bedding Material and Select Fill Testing: Gradation test shall be made on each sample in accordance with ASTM C136.

    2. Compaction Testing: Compaction shall be made in randomly selected locations in accordance with ASTM D1556 or ASTM D2922 as follows:

Material	Test Frequency
Bedding	1 per 600 linear feet/2000 sq. ft.
Select and General Fill Material	1 per lift per 2500 sq. ft.

END OF SECTION 02201

SECTION 02280

SOIL TREATMENT

PART 1 - GENERAL

1.1 SUMMARY: Provide soil poisoning to control subterranean termites as specified herein and needed for a complete and proper treatment.

1.2 SUBMITTALS:

A. Product data: Submit Manufacturer's specifications and other data needed to prove compliance with the specified requirements;

Manufacturer's recommended installation procedures which, when approved by the Contracting Officer, will become the basis for accepting or rejecting actual application procedures used on the work.

1.3 QUALITY ASSURANCE:

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary task and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Qualifications of Subcontractor: Properly licensed to provide such services by the Guam Environmental Protection Agency (GEPA).

Not less than two (2) years successful experience in soil treatment for subterranean termites.

1.4 WARRANTY: Upon completion of the Work, and as a condition of its acceptance, deliver to the Contracting Officer two (2) copies of the Warranty signed by an authorized representative of the installing subcontractor, and co-signed by the Contractor, agreeing:

A. To make an inspection of the Work once each year for a total period of two (2) years following Date of Substantial Completion for the purpose of detecting termite infestation;

B. If termite infestation is found during that 2 year period, to re-treat in accordance with prevailing practices of the trade and within ten (10) calendar days after such infestation is discovered;

C. To repair damage to the Work caused by subterranean termites during that 2 year period;

D. To make such inspections, re-treatment, and repairs at no additional cost to the Owner.

1.5 DELIVERY, STORAGE, AND HANDLING: Comply with the manufacturer's standard procedures for delivery, storage and handling of the chemicals.

PART 2 - PRODUCTS

2.1 MATERIALS: Provide termiticides currently registered by the EPA or approved for such use by the Guam Environmental Protection Agency (GEPA). Select non-repellant termiticide for maximum effectiveness and duration after application. The selected termiticide shall be suitable for the soil and climatic conditions at the project site.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS: Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 APPLICATION:

Begin soil poisoning only after all preparation for slab or footing placement is completed and inspected by a representative from GEPA.

For horizontal barriers, applications shall be made using a low-pressure spray after grading is completed and prior to the pouring of the slab or footing.

For a 1% rate, apply 1 gallon of dilution per 10 square feet, or use 2-2/3 fluid ounces of the above chemicals per 10 square feet in sufficient water to provide thorough and continuous coverage of the area being treated.

If the fill is washed gravel or other coarse material, it is important that a sufficient amount of dilution be used to reach the soil substrate beneath the coarse fill.

If concrete slabs cannot be poured over the soil the same day it has been treated, a vapor barrier should be placed over the treated soil to prevent disturbance of the termiticide barrier.

For vertical barriers, apply the 1.0% dilution at a rate of 4 gallons per 10 linear feet per foot of depth. Establish vertical barriers in areas such as around the base of foundations, plumbing lines, backfilled soil against foundation walls and other areas, which may warrant more than just a horizontal barrier.

Rodding and or trenching applications should be made to reach the top of the footing. Rod holes should be spaced to provide a continuous barrier.

Trenches need not be wider than 6 inches. Treat soil with the dilution as it is being replaced in the trench. For a 1.0% rate, apply 4 gallons of dilution per 10 linear feet per foot of depth or 10 2/3 fluid

ounces of the above chemicals per 10 linear feet per foot of depth from grade to top of footing in sufficient water to ensure complete coverage.

Hollow block foundations or voids of masonry can be treated to make a complete chemical barrier especially if the soil was snot treated prior to pouring the footing. Apply the dilution at a rate of 2 gallons per 10 linear feet so that it reaches the top of the footing.

For crawl spaces, establish a vertical barrier on both sides of the foundation and around all piers and areas where underground utilities exit the soil. Do not apply the dilution to the entire surface area intended as the crawl.

3.3 GEPA INSPECTION: If necessary, two (2) days minimum prior to application of soil poisoning, the contractor shall submit a request for inspection to GEPA.

END OF SECTION 02280

SECTION 02203

BASE COURSE FOR ROADS & DRIVEWAYS

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: The latest issues of the following publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1. American Society for Testing and Materials (ASTM) Publications:

C117	Test Methods for Materials Finer than No. 200 Sieve In mineral Aggregates by Washing.
C131	Test Methods for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Use of the Los Angeles Machine.
C136	Method for Sieve Analysis of Fine and Coarse Aggregate.
D4318	Liquid Limit, Plastic Limit and Plasticity Index of Soils.
D1140	Amount of Material in Soils Finer Than the No. 200 Sieve.
D1556	Test Method for Density of Soil in Place by the Sand Cone Method.
D1557	Moisture-Density Relations of Soils Using 10-lb. Rammer and 18-inch Drop.
D1883	Test Method for CBR (California Bearing Ratio) of Laboratory-Compacted Soils.
D2217	Practice for Wet Preparation of Soils Samples for Particle-Size Analysis and Determination of Soil Constants.
D2922	Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

1.2 QUALITY CONTROL: The Quality Control provisions apply to this section. All approvals, except those required for field installations, field applications, and field tests, shall be obtained before construction is started and before delivery of materials or equipment to the project site.

1.3 CERTIFIED TEST REPORTS: Before delivery of materials and equipment, five certified copies of the reports of all tests required in referenced publications or specified herein, shall be submitted and approved. The testing shall have been performed in a laboratory meeting the requirements specified.

The tests shall have been performed within three years of submittal of the reports for approval. Tests reports shall be accompanied by notarized certificates from the manufacturer certifying that the tested material and equipment is of the same type, quality, manufacture, and make as that proposed to be supplied. Certified test reports are required for the following:

A. Plasticity Index.
B. R-Value.
C. Liquid Limit.
D. Aggregate gradation.
E. L.A. Abrasion.
F. Sand equivalent.

1.4 DELIVERY AND STORAGE: Materials delivered to the site shall be inspected for damage, unloaded and sorted with a minimum of handling. Aggregates shall be stored in such a manner as to prevent segregation.

PART 2 - PRODUCTS

2.1 MATERIALS: Base Course shall consists of crushed coralline limestone meeting the requirements indicated herein:

(a) Mechanical Analysis:

Sieve Size	Percentage Passing
2 inches	100
1-1/2 inches	90 - 100
3/4 inches	50 - 80
No. 4	30 - 60
No. 40	15 - 30
No. 200*	5 - 13*

*For base course, the fraction passing the No. 200 sieve shall not be greater than one-half (1/2) the fraction passing the No. 40 sieve. Final acceptance samples for gradation tests will be taken by the Engineer just prior to spreading of base materials. Compaction testing may be performed by the Owner following compaction of the roadbed, or before placing of bituminous materials.

(b) Liquid Limit: Not greater than 25.

(c) Plasticity Index: Not greater than 6

(d) R-Value: Not less than 70

(e)	Los Angeles Abrasion:	Not greater than 45
(f)	Sand Equivalent:	Not less than 35

PART 3 - EXECUTION

3.1 CONSTRUCTION:

1. General: The graded aggregate base course shall be constructed on a previously constructed subbase course, as indicated. The base course shall consist of aggregate processed, deposited, spread and weather conditions detrimentally affect the quality of the base course. It shall be the responsibility of the Contractor to protect all areas of complete base course against any detrimental effects. Areas of base course that are damage by weather conditions, during any phase of construction, shall be reconditioned, reshaped, and recompacted in conformance with the requirements of this specification without additional cost to the Owner. Line and grade stakes shall be provided as necessary for control. Grade stakes shall be placed in lanes paralleling the centerline of the area to the paved, and suitably spaced for string lining.

2. Mixing of Materials: Coarse and fine aggregate shall be mixed in a stationary plant, or in a traveling plant. Coarse and fine aggregates shall be proportioned by weight or by volume in such quantities that specified gradation, liquid limit, and plasticity index requirements shall be met after the base course has been placed and compacted. Water measured by weight or by volume in quantities sufficient to provide the necessary moisture content for the specified compaction, shall be incorporated during the mixing operation. Mixing operations shall produce satisfactory uniform blending and the method of discharging into trucks shall to produce segregation.

3. Placing: Mixed material shall not be dumped in piles, but shall be placed in layers of 8 inches uniform thickness with a spreader or tailgate spreading. No layer shall exceed 6 inches or be less than 3 inches when compacted. Layers shall be so placed that when compacted they will be true to grades or levels required with the least possible surface irregularities. Where the base course is constructed in more than one (1) layer, the previously constructed layers shall be cleaned of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms. Water content of the material shall be maintained during the placing period as required to obtain the compaction specified. Adjustment in placing procedures or equipment shall be made as required to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to insure a satisfactory base course.

4. Road-Mix Methods: The aggregate shall be placed in a layer of uniform thickness, on the underlying course, without segregation of sizes, followed by placing thereon a uniform layer of

binder material to such loose depth and proportions that, when mixed and compacted, the finished layer will conform to the requirements specified. The materials shall be spread in layers of uniform thickness. The layers shall be mixed with blade graders or other approved equipment in a manner which does not disturb or mix material from the underlying course into the layer. Mixing shall be continued until the mixture is uniform throughout, adding water as necessary by means of the sprinkling equipment. The surface shall be finished to the required contour and grades. In lieu of placing the materials in layers, the aggregates and binder material may be placed on the underlying course in windrows of such cross-section and proportions that, when mixed and compacted, the layer will conform to the requirements specified.

5. Compacting and Finishing: Immediately following the mixing, the finished mixture shall be spread uniformly in a layer and brought to optimum moisture content. The loose thickness and the surface of the layer to be compacted shall be such that the density specified and the required thickness will be obtained after compaction with the equipment to be used. The layer shall be compacted with steel-faced, vibrating or pneumatic-tired rollers, or other suitable compacting equipment or combinations thereof.

   Compacting shall be continued until the layer is compacted through the full depth to a field density of at least 98 percent of the tests less than 98 percent of the maximum density and none less than 95 percent of maximum density when tested by MODIFIED PROCTOR density test in accordance with ASTM D1557 Method D. In all areas not accessible to rollers or compactors, the mixture shall be compacted with mechanical hand tampers. If the mixture is excessively moistened by rain, it shall be aerated by means of blade graders, or other suitable equipment, until the moisture content of the material is such that, when the material is compacted, the required density is obtained. The surface of the layer shall be finished by a combination of rolling and blading, and shall be smooth from waves and inequalities.

6. Finishing at Edges of Base Course: Earth or other approved material shall be placed along the edges of the base course in such quantity as will compact to the thickness of the course being constructed, or, when the course is being constructed in two or more layers, to the thickness of each layer of the course, allowing in each operation at least a one-foot width of the shoulder to be rolled and compacted simultaneously with the rolling and compacting of each layer of the base course.

7. Maintenance: After construction is completed, the base shall be maintained throughout except where portion of the succeeding course is under construction thereon. Maintenance shall include drainage, rolling, shaping, and watering as necessary to maintain the course in proper condition. Deficiencies in thickness, composition, construction, smoothness, or density, which develop during the maintenance, shall be corrected to conform to the requirements specified hereinbefore. Sufficient moisture shall be maintained at the surface to prevent a dusty condition, by light sprinkling with water. Before the application of the prime

coat, the base course shall be permitted to partially dry until the average moisture content of the full depth of the base is less than 80 percent of the optimum moisture of the base mixture.

3.2 FIELD SAMPLING AND TESTING: Samples shall be supplied by the Contractor as specified herein at the expense of the Contractor. Testing will be conducted by the Contractor at his expense. All material and material sources will be approved by the Engineer 7 days prior to the use of such material in the work.

1. Sampling:

    1. Aggregates at Source: Prior to production and delivery of aggregates, at least one initial sample shall be taken in accordance with ASTM D75 from each stockpile. Each sample shall be collected by taking three incremental samples at random from the source material to make a composite sample of not less than 50 pounds. Three random samples shall be taken from each 3000 tons of material, or a day's run, thereafter during the course of the project. A repetition of the above sampling shall be made when the source of material is changed or when unacceptable deficiencies or variations from the specified grading or materials are found in testing.

    2. Sample Identification: Each sample shall be placed in a clean container which shall be securely fastened to prevent loss of material. Each sample shall be tagged for identification. The tag shall contain the following information:

        Contract No.:_____
        Sample No.: _____ Quantity: _____
        Date of Sample: _____
        Sampler: _____
        Source: _____
        Intended Use: _____
        For Testing: _____

2. Testing:

    1. Aggregate Testing: Gradation tests shall be made on each sample without delay. All other aggregate test shall be made on the initial source samples, and shall be repeated when there is a change of source. Sieve analyses shall be made from each sample collected during the course of the project. The test shall include an analysis of each grade of material and analysis of the combined material representing the aggregate part of the mix. Sieve analysis shall be in accordance with ASTM C136. Material retained on each sieve shall not vary from the approved job curve by more than 7 percentage points, plus or minus. Sieve analysis on material passing the No. 200 sieve shall be made in accordance with ASTM D1140.

2. Smoothness Test: Deviations in the surface in excess of 3/8 inch when tested with a 10-foot straightedge, applied parallel with and at right angles to the centerline of the paved area, shall be corrected by loosening, adding or removing material, reshaping, watering, and compacting. When the base course is to be constructed in more than one layer, the smoothness requirements specified above shall apply only to the top layer.

3. Field Density Tests: Field density tests shall be in accordance with ASTM D1556 D2922. There shall be one field density test for each 2000 square yards of each layer of base material.

4. Laboratory Density Tests: Laboratory density tests shall be performed in accordance with ASTM D1557, Method D, for all material which does not have more than 5 percent retained on the 3/4 inch sieve. The material shall be rolled and compacted using the equipment approved for the project, and density and moisture determinations will be performed in accordance with ASTM D1556 or ASTM D2922 to establish optimum moisture and maximum density.

5. Thickness Test: The thickness of the base course will be measured at intervals such that there will be a depth measurement for at least each 500 square yards of complete base course. The depth measurements shall be made by test holes, at least 3 inches in diameter, through the base course. Where the base course deficiency is more than 1/2 inch, such areas shall be corrected by scarifying, adding mixture of proper gradation, blading, and recompacting. Where the measure thickness is more than 1/2 inch thicker than shown, it shall be considered as the indicated or specified thickness plus 1/2 inch for determining the average. The average thickness shall be the average of the depth measurements and shall not underrun the thickness indicated by more than 1/4 inch.

END OF SECTION 02203

SECTION 02600

PLANT MIX BITUMINOUS PAVEMENT

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: The latest issues of the publications listed below, but referred to thereafter by basic designation only, form a part of this specifications to the extent indicated by references thereto:

1. American Association of State Highway and Transportation Officials (AASHTO):

M20	Penetration Graded Asphalt Cement.
T11	Amount of Material Finer than 0.075 mm (No. 200) Sieve.
T27	Sieve Analysis of Fine and Coarse Aggregate.
T30	Mechanical Analysis of Extracted Aggregates.
T89	Determining the liquid Limit of Soils.
T90	Determining the Plastic Limit and Plasticity Index of Soils.
T96	Resistance to Abrasion of Small-Size Course Aggregate by Use of the Los Angeles Machine.
T102	Spot Test of Asphaltic Materials.
T104	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
T201	Kinematic Viscosity of Asphalts

2. American Society for Testing and Materials (ASTM):

C131	Test Methods for Resistance of Small-Size Coarse Aggregate by Abrasion and Impact in the Use of Los Angeles Machine.
C136	Test Method for Sieve Analysis of Fine and Coarse Aggregates.
D75	Practice for Sampling of Aggregates.

D140 Sampling Bituminous Materials.

D242 Specification for Mineral Filler for Bituminous Paving Mixtures.

D546 Test Method for Sieve Analysis of Mineral Filler.

D946 Paving Materials Specifications for Penetration-Graded Asphalt Cement for Use in Pavement Construction.

D1188 Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens.

D1559 Test for Resistance to Plastic Flow of Bituminous Mixture Using Marshall Apparatus.

D1664 Test Method for Coating and Stripping of Bitumen-Aggregate Mixtures.

D2172 Test Method for Quantitative Extraction of Bitumen from Bituminous Paving Mixtures.

D2950 Density of Bituminous Concrete in Place by Nuclear Method.

3. The Asphalt Institute Manuals:

MS-1 Thickness Design.

1.2 QUALITY CONTROL: All approvals, except those required for field installations, field applications and field tests, shall be obtained before construction is started and before delivery of materials or equipment to the project site.

1.3 SUBMITTALS:

1. Samples: Samples of the following materials shall be submitted and approved in accordance with the requirements of the general provisions:

1. Asphalt cement.
2. Course aggregate.
3. Fine aggregate.
4. Mineral filler.

2. Certified Test Reports: Before delivery of materials and equipment, five certified copies of the reports of all tests required in referenced publications or specified herein shall be submitted and approved. The testing shall have been performed in a laboratory meeting the requirements specified. The tests shall have been performed within 3 years of submittal of the reports for approval. Tests certifying that the tested material and equipment is of the same type, quality, manufacture, and make as that proposed to be supplied. Certified test reports are required for the following:

    1. Asphalt cement.

3. Job Mix Formula: A job-mix formula shall be submitted by the Contractor and shall be approved prior to placing of the bituminous mixture.

    The Formula shall indicate the definite percentage of each sieve fraction, the percentage of bitumen, and the temperature of the completed mixture as discharged from the mixer. Variations in the approved job-mix formula shall not exceed the following:

Aggregate passing No. 4 sieve or larger:	5% plus or minus
Aggregate passing No. 10, 40 and 80 sieves:	4% plus or minus
Aggregate passing No. 200 sieves:	1.5% plus or minus
Asphalt:	0.3% plus or minus
Temperature of mixing:	25% degrees F (+/-)

    Adjustments of the bitumen content and aggregate gradation, within the limits specified herein, to improve the paving mixtures, shall be made as directed, without adjustment in the contract price.

1.4 DELIVERY, STORAGE, AND HANDLING: All materials shall be delivered to the central mixing plant and stored in their designated areas. Mixed materials shall be hauled directly to the point of use in the site immediate placement.

1. Central Mixing Plant: Sufficient storage space shall be provided at the bituminous mixing plant for each size of aggregate. The different aggregate sizes shall be kept separated until they have been delivered to the cold elevator feeding the drier. The storage yard shall be neat and orderly, and the separate stockpiles readily accessible for sampling. The plant shall include storage bins of sufficient capacity to supply a mixer operating at full capacity. Bins shall be arranged to ensure separate and adequate storage of appropriate

fractions of the mineral aggregates.

2. Hauling Equipment: Trucks used for hauling bituminous mixtures shall have tight, clean, smooth metal beds. To prevent the mixture from adhering to them, the beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other approved material.

3. Delivery: Loads shall not be sent out as to interfere with spreading and compacting the mixture. During nighttime operations, artificial light, satisfactory to the Engineer, shall be provided. The mixture shall be delivered at a temperature within the tolerance allowed in the approved job formula.

1.5 GENERAL REQUIREMENTS: The bituminous hot-mix pavement course shall be constructed on a previously primed base course. The bituminous pavement course shall consist of mineral aggregate, uniformly mixed with hot bituminous material in Bituminous courses shall be constructed when the underlying course is dry. Line and grade stakes shall be provided as necessary for control. Grade stakes shall be placed in lanes paralleling the center line of the area to be paved, and suitably spaced for string lining.

PART 2 - PRODUCTS

2.1 MATERIALS:

1. Aggregates: The aggregates shall consist of crushed limestone obtained from sources previously approved for such use, clean, hard, sound and free from deleterious coatings, disintegrated material, lumps of clay, and particles of vegetation. The coarse aggregate retained on the No. 4 sieve shall have a percentage of wear not be exceed 40 after 500 revolutions as determined by ASTM. Standard, Designation C131. The coarse more than 5 percent materials passing the No. 8 sieve. The fine or coarse aggregate or a composite mixture shall show no detrimental amount of stripping when tested in accordance with ASTM D1664.
2. Bituminous Materials: The bituminous materials to be mixed with the mineral aggregates, unless otherwise specified on the project drawings, shall be an asphaltic cement conforming to the requirements of ASTM D946 penetration grade 60-70 or 85-100.

3. Composition of Mixture: The gradation of the mineral aggregate shall be as specified below. The percentage of bituminous material, by weight, used in the bituminous mixtures shall be within the limits specified except that the upper limit shall be increased as necessary, if the mineral aggregate is porous.

Percentage by Weight Passing Square Mesh

Laboratory Sieves

SIEVE	MIXTURE
1 - inch	100
3/4-inch	85 - 100
1/2-inch	72 - 87
No. 4	45 - 60
No. 10	32 - 47
No. 40	16 - 26
No. 80	10 - 18
No. 200	4 - 8
Asphalt	5 - 9

For the bituminous mixture, the stability and flow, as determined by the Marshall method, shall be as follows:

Number of blows of compaction hammer on side of molded specimen	50
Stability (minimum) pounds	1000
Flow (maximum), hundredths of an inch	3-5
Percent voids filled with asphalt	70-85

The aggregate shall be graded uniformly from coarse to fine and shall not vary from the low limit on the adjacent sieve. The grading is based on aggregates of uniform specific gravity, and the percentages passing the various sieves are subject to appropriate correction when aggregates of varying specific gravities are used.

2.2 CONSTRUCTION EQUIPMENT:

1. General: All equipment shall be dependable and adequate for the purpose intended and shall be properly maintained in satisfactory and safe operating condition at all times. Calibrated equipment such as asphalt distributors, scales, batching equipment, spreaders and similar equipment, shall have been re-calibrated by a calibration laboratory recommended by the Contractor and approved by the Engineer within 12 months of commencing work and every 12 months thereafter, by such laboratory from the date of

recalibration, during the term of the contract.

2. Plant Requirements: The mixing plant shall be designed, coordinated, and operated to produce a mixture within the job-mix formula tolerances. The plant may be either a weight-batch type or a rotary-drum type and shall have a minimum capacity of 60 tons per hour. Volumetric-proportioning, continuous mixing type may be substituted for the above types, provided the equipment is suitable for producing finished mixtures complying with the job-mix formula specified herein. The mixing plant and equipment shall remain accessible at all times for checking its adequacy, inspecting its operation, verifying weights, proportions, and character of materials, and checking mixture temperatures.

   Prior to the start of the mixing work, the Contractor shall obtain the Engineer's written approval of the mixing plant's capacity, equipment, controls, mixing procedure and other relevant appurtenances. This approval will be based on compliance with minimum plant requirements, a copy of which can be obtained at the Highway Division, Department of Public Works.

PART 3 - EXECUTION

3.1 MIXING AND TRANSPORTING:

1. Mixing: The bituminous mixture shall be produced in an approved plant specified hereinbefore. The fine and coarse aggregates shall be piled in separate piles and fed to the dryer by separate mechanical feeders in a manner to produce a bituminous mixture within the tolerances specified for the job-mix formula. When two or more fine aggregates or two or more coarse aggregates of varying gradation are used, pre-mixing by satisfactory methods may be required prior to being placed in the separate piles. The aggregates shall be heated and dried thoroughly before being placed in the bins. The temperature of the aggregates, determined as they are placed in the mixer, shall be such that the temperature of the finished mixture will be within the tolerances specified.

   The heated and dried aggregates shall be screened, separated into the sizes as directed or approved, conveyed to separate bins and held ready for mixing with the bituminous material. Adequate dry storage shall be provided for mineral filler at the mixing plant. After, the aggregates have been prepared properly, they shall be accurately weighed or measured and conveyed into the mixer in the proportionate amounts of each aggregate size required.

   The required amount of the asphalt for each batch, or calibrated amount for continuous mixing, shall be introduced into the mixer. In batch mixing, the aggregates shall be charged into the mixer and shall be mixed for not less than 15 seconds, the asphalt

added, and mixing continued for at least 20 seconds or longer, as may be necessary to obtain a homogeneous mixture.

When a continuous mixer is used, the mixing time shall be not less than 30 seconds, or longer as may be necessary to obtain a homogeneous mixture. The additional mixing time, when required, shall be as directed. The temperature of the asphalt at the time of mixing shall not exceed 325 degrees F. The temperature of the aggregate and mineral filler in the mixer shall not exceed 350 degrees F when the asphalt is added.

The temperature of the aggregates and asphalt at the time of mixing shall be as directed. When prepared in a twin pug-mill mixer, the depth of the mixer shall not be greater than the tips of the mixer blades when the blades are in a vertical position. All overheated and carbonized mixtures, or mixtures which foam or show indication of moisture, will be rejected. When moisture is detected in the finished mixture, all aggregates in the bins shall be removed and placed in their respective stockpile.

B. Transportation of Bituminous Mixture: The bituminous mixture shall be transported from the paving plant to the site in trucks having tight, clean, smooth beds which have been oiled with a minimum amount of approved thin oil to prevent adhesion of the mixture to the truck bodies. Each load shall be covered with canvas or other suitable material of ample size to protect it from weather and to prevent the loss of heat. Deliveries shall be made so that spreading and rolling of all the mixture prepared for a day's run can be completed during daylight, unless satisfactory artificial light is provided. The mixture shall be delivered to the area to be paved in such manner that the temperature at the time of dumping into the spreader will not be less than that specified. Any loads wet excessively by rain will be rejected. Hauling over freshly laid material will not be permitted.

3.2 CONSTRUCTION REQUIREMENTS:

1. Equipment: Equipment used in the performance of the work shall be subject to approval, and shall be maintained in a satisfactory working condition at all times.

    1. Spreaders. Spreaders shall be the self-propelled type, equipped with hoppers, distributing screws, adjustable screens, and equalizing devices, capable of spreading hot bituminous mixtures without tearing, shoving, or gouging, and of producing a finished surface of specified evenness. Spreaders shall operate, when laying mixtures, at such speed between five and forty-five feet per minute, as may be directed. They shall be equipped with a quick and efficient steering device and shall have a forward and reverse traveling speed of not less than one hundred feet per minute.

Unless operating on fixed side forms, pavers shall employ mechanical devices such as equalizing runners, straight-edge runners, leveler arms, or other compensating devices to adjust to grade and confine the edges of the mixtures to true lines without the use of side forms.

2. Rollers. Rolling equipment shall consist of self-propelled rollers of tandem and pneumatic-tired types, Tandem rollers shall weigh not less than 10 tons. Pneumatic-tired rollers shall be of the double-axle type, equipped with pneumatic tires of equal size and diameter. Tires shall be uniformly inflated so that the air pressure in the several tires will not vary more than 5 pounds per square inch and so arranged that the tires on one axle will cover the gap between the tires on the other axles.

   Pneumatic-tired rollers shall be varied to produce an operating weight per tire from 1,000 pounds minimum to a maximum of 2,000 pounds as directed. All rollers shall be suitable for rolling hot-mix bituminous pavements and shall be capable of reversing without backlash. Pneumatic-tired rollers shall be capable of being operated both forward and backward without turning on the mat, and without loosening the surface being rolled. Rollers shall be equipped with suitable devices and apparatus to keep the rolling surfaces wet and prevent adherence of bituminous mixture.

3. Hand Tampers. Hand tampers shall weigh not less than 25 pounds and shall have a tamping face of not more than 50 square inches. Pneumatic hand tampers shall be standard commercial type.
4. Blowers and Brooms. Blowers and brooms shall be of the power type and shall be suitable for cleaning the surface to be paved.

5. Scales. Scales shall be standard truck scales of the beam type. The scales shall be of sufficient size and capacity to accommodate all trucks to be used for handling bituminous mixtures. All scales shall be tested, as directed, and the necessary number of standard weights for testing the scales shall be on hand at all times.

2. Placing: The bituminous mixture shall be spread by self-propelled mechanical spreading and finishing equipment with a screen or strike-off assembly capable of spreading the bituminous material to a uniform thickness and density on the required cross-section without the use of side forms. Thickness of the compacted pavement shall not exceed 2" for any single course. All pavement specified in excess of 2" shall be built up in successive course of 1" to 1/2" compacted thickness. Segregation of the coarse and fine portions of mix shall be prevented.

All asphalt with a temperature of less than 225 degrees F when dumped in the mechanical spreaders shall be rejected. Unless directed otherwise, placing shall begin along the centerline of areas to be paved on a crown section and at the high side of a section with a one-way slope. The length of any strip to be laid, before placing the succeeding strip, shall be as directed. Contractor must provide two calibrated heat testing devices to Engineer prior to receiving first load of bituminous mixture.

Placing of the mixture shall be as continuous as possible. Experienced shoveler and rakers shall follow the spreading machine, adding hot mixture and raking. Where the use of machine spreading is impractical, the mixture may be spread by hand. The mixture shall be dumped on approved dump boards outside the area to be paved, distributed into place by means of hot shovels, and spread with hot rakes. The finished surface shall not deviate more than 1/4" when tested with a 12 foot straightedge. The loads shall not be dumped faster than can be handled by the shoveler and rakers. Rakers not equipped with stilt sandals shall not stand in the hot mixture while raking the course. Contact surface of previously constructed pavement, curbs, manholes and similar structures shall be painted with a thin coat of hot bituminous material prior to placing the bituminous mixture.

3. Compaction of Mixture: Compaction by rolling shall begin without delay as soon as the mixture will bear the roller without undue displacement. Rolling shall start longitudinally at the extreme sides of the lane, proceeding toward the center of the pavement, overlapping on successive trips by at least one-half the width of the rear wheel of the roller. Alternate trips of the roller shall be slightly different lengths. Initial longitudinal rolling shall completely cover the freshly spread asphalt mixture and shall be performed with a two-axle or three-axle tandem roller. Tests for conformity with the specified crown, grade, and smoothness shall be made by the Contractor immediately after initial compression. Before continuing the rolling, any variations shall be corrected by removing or adding materials as directed. The course shall then be subjected to three complete coverages with a pneumatic-tired roller, while the temperature of the mixture is above 150 degrees F.

Final rolling of the uppermost layer shall be performed with a tandem roller. The speed of the rollers shall not exceed 3 miles per hour and shall at all times be slow enough to avoid displacement of the hot mixture.

Any displacement of the mixture shall be corrected at once by the use of rakes and fresh mixture applied or removed as required. Rolling shall be continued until all roller marks are eliminated and the course has a density of at least 96 percent of the density obtained in a laboratory specimen of the same mixture when subjected to 50 blows per side when tested by T-230-68. During rolling, the wheels, but an excess of water will not be permitted. One pneumatic-tired roller and one tandem roller shall be provided for each

spreading machine in operation on the job.

Additional 10-ton rollers shall be provided if the specified pavement density is not obtained by the operation of the minimum number of rollers. In places not accessible to rollers, the mixture shall be compacted with hot hand tampers. Skin patching of an area that has been rolled will not be permitted. Any mixture that become mixed with foreign material or is defective shall be removed, replaced with fresh mixture, and compacted to the required density. The roller shall pass over the unprotected edge of the course only when the laying of the mixture is to become cold. After final rolling, no vehicular traffic of any kind shall be permitted on the pavement until it has cooled, and hardened, and in no case, less than 6 hours.

4. Joints: All joints shall have the same texture, density, and smoothness as other sections of the course. Joints between old and new pavements or between successive day's works shall be made carefully in a manner to ensure a continuous bond between old and new sections of the course. All contract surfaces of previously constructed pavement shall be coated with a thick, uniform coat of hot bituminous material immediately before the fresh mixture is placed.

Except when a canvas-rope joint cloth is used, the edge of the previously laid course shall be cut back to expose an even, vertical surface for the full thickness of the course. The fresh mixture shall be raked against the joints, thoroughly tamped with hot tampers, and smoothed with hot smoothers, followed by rolling.

Longitudinal joints shall be placed so that the joint in the surface layer will not coincide with that of the lower layer course and will break by at least 6 inches. However, the joint in the top layer shall be at center line of the pavement if the roadway comprises two lanes of width or at lane lines, if the road is more than two lanes in width unless otherwise directed by the Engineer. When the edges of the longitudinal joints are irregular honeycombed, or poorly compacted, all unsatisfactory sections of Joint shall be cut back to expose an even, vertical surface for the full thickness of the course. Where required, fresh mixture shall be raked against the joint, thoroughly tamped with hot tampers, and smoothed with hot smoothers, followed by rolling:

3.3 SAMPLING AND TESTING:

1. Sampling:

1. Materials: All material samples shall be supplied by the Supplier at his expense. All material and material sources shall be approved prior to use of material in the work, and samples, shall be submitted for approval not less than 15 working days

before such aggregates are to bed. Additional samples of materials shall be furnished during construction, upon request. Sampling shall be in accordance with Specification No. S-R-406, except as specified otherwise. Asphaltic materials may be accepted on the basis of a certificate of compliance by the producer that the material conforms to these specifications.

2. Pavement and Mixtures: Suitable sized samples for the determination of thickness and density of the completed pavement shall be removed by the Contractor at his expense. The Contractor shall cut samples and satisfactorily replace the pavement. Samples of the plant mixtures will be taken and tested for each 400 tons or fraction thereof mixed. Pavement which fails to meet the requirements specified shall be removed and replaced as directed.

2. Tests: All tests to determine conformance with the specified requirements will be performed by the Government.

1. Job-Mix Test. Samples of the plant mixtures will be tested for each 400 tons or fraction thereof of finished mixture to determine gradation and bitumen content.

3. Testing of Pavement Course:

1. Density: Density of the pavement shall be determined on cores obtained from the binder or wearing course in accordance with ASTM D1188. Two cores shall be tested for 200 tons, or fraction thereof, of asphalt placed. Cores will be tested by ASTM D2726 or D1188 whichever applies.

In lieu of the core method of density determination, acceptance testing may be accomplished with a nuclear device in accordance with ASTM D2950. The nuclear density test shall then be correlated with the density of cored samples. If the mean density determined from cored samples and nuclear density tests is at least 96 percent, the density determination by nuclear device will be accepted but correlation of the device by core shall be done every 400 tons.

2. Thickness: Thickness of the binder and course shall be determined on cores taken for the density test.

3. Surface Test: The compacted surface of the binder course and wearing course shall be straightedge tested as the work progresses. The straightedge shall be applied parallel with and at right angles to the centerline after final rolling. Unevenness of the binder course shall not vary more than plus or minus 1/4 inch in ten feet; variations in the wearing course shall not vary more than plus or minus

1/8 inch in ten feet. Any portion of the pavement showing irregularities greater than that specified shall be corrected as directed by the Owner. The finished surface shall also not vary more than 0.03 foot above or below the plan grade line or elevation at any point. After the completion of final rolling, the smoothness of the course shall again be tested: humps or depressions exceeding the specified tolerances or that retain water shall be repaired to meet the above tolerance, as directed by the Engineer. This shall be done at the Contractor's expense.

END OF SECTION 02600

SECTION 02601

BITUMINOUS PRIME COAT

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: The latest issues of the following publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1. American Association of State Highway and Transportation Officials (AASHTO) Publication:

   T102 Spot Test of Asphaltic Materials.

2. American Society for Testing and Materials (ASTM) Publications:

   D140 Sampling Bituminous Materials.

3. Federal Specification (FS):

   SS-A-674C Emulsified Asphalt.

1.2 QUALITY CONTROL: The Quality Control section apply to this section. All approvals, except those required for field installations, field applications, and field tests, shall be obtained before construction is started and before delivery of material or equipment to the project site.

1.3 CERTIFIED TEST REPORTS: Before delivery of materials and equipment, five certified copies of the reports of all tests required in referenced publications or specified herein shall be submitted and approved. The testing shall have been performed in a laboratory meeting the requirements specified. The tests shall have been performed within three years of submittal of the reports for approval. Test reports shall be accompanied by notarized certificates from the manufacturer certifying that the tested material and equipment is of the same type, quality, manufacture, and make as that proposed to be supplied. Certified test reports are required for the following:

   a. Asphalt material:

1.4 DELIVERY OF STORAGE: Material delivered to the site shall be inspected for damage, unloaded, and stored with a minimum of handling.

1.5 GENERAL: The bituminous prime coat shall be applied on a previously prepared base course.

PART 2 - PRODUCTS

2.1 MATERIALS: Bituminous materials shall be a slow setting emulsified asphalt conforming to Federal Specification SS-A-674C, designation SS-1. Emulsified Asphalt shall be mixed with water in the proportion of 2 or 3 parts of potable water to one part of emulsified asphalt.

2.2 QUANTITIES TO BE APPLIED: The rate of application shall be not less than 0.25 gallon nor more than 0.50 gallon per square yard. The actual rate of application will be determined in the field.

2.3 EQUIPMENT, TOOLS, AND MACHINES: Equipment, tools, and machines used in the performance of the work required by this section, shall be subject to approval, by the Engineer and shall be maintained in satisfactory working condition.

1. Bituminous Distributor: Bituminous distributor shall have pneumatic tires of such width and number that the load produced on base surface shall not exceed 650 pounds per inch of tire width. The distributor shall be designed and equipped to distribute the bituminous material uniformly at even heat on variable widths of surface up to 15 feet at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard, with a pressure range of 25 to 75 pounds per square inch and with an allowable variation not to exceed 5 percent from any specified rate. Distributor equipment shall include a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gages, volume-measuring devices, adequate heaters for heating the materials to the proper application temperature, a thermometer to show the temperature of tank contents, and a hose attachment suitable for applying bituminous shall be equipped to circulate and agitate the bituminous material during the heating process.

2. Heating Equipment for Storage Tanks: The equipment for heating bituminous material shall consist of steam coils and equipment for producing material steam, so designed that steam cannot get into the material. An armored thermometer with range from 40 degrees F to 400 degrees F shall be fixed to the tank so that the temperature of the bituminous material may be read at all times.

3. Brooms and Blowers: Brooms and blowers shall be of the power type and shall be suitable for cleaning prepared subgrade or bases.

PART 3 - EXECUTION

3.1 WEATHER LIMITATIONS: The prime coat shall be applied only when the subgrade, subbase, or base course is dry or contains moisture not in excess of the amount that will permit uniform

distribution and the desired penetration. The prime coat shall be applied only when the ambient temperature is 55 degrees F or above and when the weather is not foggy or rainy, unless otherwise directed.

3.2 PREPARATION OF SURFACE: Immediately before applying the prime coat to the surface that is to be primed, all loose material, dirt, clay, or other objectionable substance shall be removed from the surface by means of a power broom or blower supplemented with hand brooms. After the cleaning operation and prior to the application of the prime coat, an inspection of the area to be primed will be made by the Engineer to determine the fitness of the areas to receive the bituminous priming material.

3.3 APPLICATION OF BITUMINOUS MATERIAL: Immediately following the preparation of the base course for treatment, the bituminous material shall be applied by means of a bituminous spreader in a uniform, continuous spread. When traffic is maintained, not more than 1/2 of the width of one section shall be traded in one application. The bituminous material shall be applied at a pressure within the range of 25 to 75 pounds per square inch and the amounts directed. The priming material shall be applied with uniform distribution at all points of the surface to be treated. Care shall be taken that the application of bituminous material at the junctions of spreads is not in excess of the specified amount. Excess bituminous material shall be squeegeed from the surface. Building paper shall be spread on the surface of the applied material for a sufficient distance back from the ends of each application so that flow from the sprays may be started and stopped on the paper, and so that all sprayers will operate at full force on the surfaced to be treated. Immediately after the application, the building paper shall be removed and destroyed. All spots unavoidably missed by the distributor shall be properly treated with bituminous material.
Following the application of prime material, the surface shall be allowed to dry without being disturbed for a period of not less than 24 hours or longer, as maybe necessary to attain penetration into the foundation course and evaporation of the volatiles from prime material, which period shall be determined by the Engineer. The Contractor shall furnish and spread enough approved sand to effectively blot up and cure any excess bituminous material. The Contractor shall maintain the primed surface until the succeeding layer of pavement is placed, by protecting the surface against damage to the base course. No smoking, fires, or flames other than the heater that are a part of the equipment shall be permitted in the vicinity of heating, distributing, or transferring operations for bituminous materials.

1. Application Temperature for Emulsified Asphalt: Application temperature for emulsified asphalt shall be as directed. Application temperatures shall be within the range of 73 to 130 degrees F.

3.4 FIELD SAMPLING AND TESTING:

1. Samples of Bituminous Materials: Samples of bituminous materials shall be furnished by

and at the expense of the Contractor. Sampling shall be in accordance with ASTM D140.

2. Tests: All tests of bituminous materials will be the responsibility of the Contractor.

    1. Spot test for asphalt will be performed in accordance with AASHTO T102.

3. Calibration Test: The Contractor shall furnish such equipment and materials and perform the work to calibrate the tank and measuring devices of the distributor. This shall be done on the job at the beginning of the work.

END OF SECTION 02601

SECTION 02713

EXTERIOR WATER DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: The latest issues of the following publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

A. Federal Specifications:

WW-P-421c	Pipe, cast iron, pressure (for water and other liquids)
WW-V-58B	Valves, Gate, Cast-Iron; Threaded and Flanged (for Land Use)
TT-P-51f	Asphalt Varnish

B. American National Standards Institute (ANSI) Publications.

A21-11	Rubber Gasket for Joint for Ductile Iron and Gray Iron Pressure Pipe and Fittings
B16.1	Cast-iron Flanges and Flanged Fittings 25, 125 250 and 800 lbs.

C. American Society for Testing and Materials (ASTM) Publications:

B61	Specification for Steam or Valve Bronze Castings
B62	Specification for Composition Bronze or Ounce Metal Castings
D1785	Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120
D2564	Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
D3139	Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
F477	Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipes

D. American Water Works Association (AWWA) Publications:

C651	Disinfecting Water Mains
M20	Manual of Water Supply Practices, Water Chlorination, Principles and Practices
C800	Underground Service Lines, Valves and Fittings.

E. Uni-Bell Plastic Pipe Association (UNI) Publications

UNI-B-3	Installation of Polyvinyl Chloride (PVC) Pressure Pipe Complying with AWWA Standard C-900

1.2 DESCRIPTION OF WORK: The work includes providing new water service lateral, connection to existing water system, and other incidental work for a complete installation.

1.3 SUBMITTALS:

1. Layout Drawings: Submit drawings for piping layout and connection to new and existing systems. Indicate locations and configurations of all fittings, valves, meters, and accessories on layout drawings. Do not have pipe, fittings, and accessories delivered to the site until layout drawings have been approved by the Engineer.

2. Manufacturer's Data: Submit manufacturer's standard drawings or catalog cuts of the following items:

    1. Pipe, fittings, joints, couplings, and gaskets
    2. Gate Valves
    3. Corporation stops
    4. Valve boxes
    5. Water Meter

3. Standards Compliance: Submit manufacturer's certificates of conformance or compliance for each of the following items:

    1. Pipe & fittings
    2. Pipe joint materials
    3. Solvent Cement
    4. Valves

5. Water Meter

1.4 DELIVERY, STORAGE, AND HANDLING OF MATERIALS:

1. Delivery and Storage: Inspect materials delivered to site for damage; unload and store with minimum handling. Store materials in enclosures or under protective covering; store rubber gaskets not to be installed immediately under cover, out of direct sunlight. Do not store directly on the ground. Keep interior of pipes and fittings free of dirt and debris.

2. Handling: Handle pipe, fittings, valves, and other accessories and appurtenances in such manner as to ensure delivery to the trench in sound, undamaged condition. Avoid injury to coatings and linings on pipe and fittings; make satisfactory repairs if coatings or linings are damaged. Carry pipe to the trench; do not drag it.

PART 2 - PRODUCTS

2.1 MATERIALS FOR WATER LINE:

3. Pipe and Fittings: Piping and fittings Shall be PVC pipe, Schedule 80 conforming to ASTM D1785. PVC pipe and fittings for service lines shall bear the seal of approval of the National Sanitation Foundation for potable water service and shall be supplied from the same material and source. Solvent cement for jointing shall conform to ASTM D2564. Installation shall conform to AWWA C800.

B. Service Saddles. Service saddles shall be bronze for all connections. Service saddles shall have a working pressure of 200 psi.

2.3 VALVES:

2. Valves 3-Inch Size and Smaller: Valves shall be the wedge disc type with non-rising stem, screw ends and brass or bronze body. Metal composition of the body, center piece and other cast parts shall be bronze meeting the requirements of ASTM B62. All packing shall have each ring cut to fit with staggered joints. Continuous (spiraled) packing shall not be used. Valves shall be provided with handwheel and stuffing box glands. Valves shall be for minimum 200 pound water service. Handwheel shall be of malleable iron.

3. Valve Boxes: Each gate valve on buried piping shall be provided with an adjustable cast-iron box of a size suitable for the valve on which it is to be used. The head shall be round and the lid shall have the word "WATER" cast on it. The least diameter of the shaft of the box shall be 10.25 inches for waterlines greater than 6 inches in diameter and 5.25 inches for waterlines 6 inches or less in diameter. Each box shall be given a heavy coat of

bituminous paint. Provide one valve key for each below grade gate valve. Valve and key shall be supplied by the same manufacturer.

4. Corporation Stops: Corporation stops shall be ground key type; shall be made of bronze conforming to ASTM B62; and shall be suitable for the working pressure of the system. Ends shall be suitable for solder-joint, or flared tube compression type joint. Threaded ends for inlet and outlet of corporation stops shall conform to AWWA C800, coupling nut for connection to flared copper tubing shall conform to ANSI B16.26.

5. Water Meter: Water meter shall be "TURBINE TYPE" in accordance with AWWA C701. Meter registers shall be straight-reading, hermetically sealed or open and shall read in U.S. gallons. The register mechanism shall not be in contact with the water that is being measured. The meter shall be suitable for a working pressure of 150 psi.

   Flanged connectors shall be oval faced. Flanges shall be of class 125, round type and shall conform to ANSI 16.1 for specified diameter, drilling and thickness.

2.4 APPURTENANCES/SPECIAL FITTINGS:

1. Warning Tape: Metallic impregnated warning tape shall be blue color with "Caution Buried Water Line Below" printed on it continuously.

2.5 CONCRETE: Concrete for pipe thrust blocks, supports and anchorages conforming to the requirements of Section 03300, entitled “Cast-In-Place Concrete.

PART 3 - EXECUTION

3.1 GENERAL: These requirements shall apply to all piping except as specified otherwise.

2. Location of Waterline Improvements: The location of water laterals and appurtenances are shown on the drawings. All mains and laterals shall be installed to the grades and elevations shown on the drawings and, unless otherwise indicated on the drawings, shall be provided with a minimum cover of 24 inches from the top of pipe to existing ground or paved surface. The allowable angle of deflection at any point shall not exceed that recommended by the pipe manufacturer for the particular pipe used.

3. Existing Utilities and Structures: The Contractor shall familiarize himself with the locations of existing utilities and structures. The location of underground utilities where shown on the plans are based upon information obtained from as-built drawings and shall not be taken as final and all-conclusive. The Contractor shall, as part of his basic work, verify with GTA, MCV, GWA, GTA, Navy PWC, and DPW the location and configuration of

existing utilities and structures which may affect or be affected by work under this project and shall be responsible for their adjustment, removal or relocation. The Contractor shall obtain clearances from all utility agencies prior to excavation for water system work.

4. Pipe Laying and Jointing: Pipe, fittings, valves and accessories will be carefully inspected by the Engineer before and after installation and those found defective will be rejected. Pipe and fittings shall be free from fins and burrs.

5. Installation of Metallic Warning Tape: Provide a continuous run of metallic warning tape for the full length of each run of nonmetallic pipe. Attach metallic warning tape to the top of the pipe to prevent displacement during construction operations.

6. Connection to Existing Water Supply System: Connect to existing systems where indicated on the drawings in a manner approved by the Engineer, Navy PWC, and GWA. Minimize interruption of service. Use tapping or drilling machine for connections to be made under pressure.

   Notify the Engineer, Navy PWC, and GWA in writing at least 15 days prior to the date when the connections are required. Furnish all materials, including piping, required to make connections to the existing water supply system and perform all earthwork, and other incidental labor and equipment as required.

   Furnish the labor and the tapping or drilling machine for making the actual connections to the existing systems.

3.2 INSTALLATION OF BURIED WATER PIPING: Install pipe and fittings in accordance with the general requirements for installation of piping, except otherwise specified herein:

The pipe shall be protected to prevent entrance of foreign material during laying operations. When laying is not in progress, open pipe ends shall be protected with a watertight plug or other approved means to exclude water or foreign material.

Perform excavation, subgrade improvement (as required), bedding and backfilling in accord with the material and construction requirements of Section 02201, entitled Earthwork for Utilities and Structures.

3.3 FLUSHING AND DISINFECTION:

7. Flushing: All foreign matter shall be flushed from the pipeline prior to disinfection. Hoses, temporary piping or other devices shall be provided to dispose of flushing water without damage to adjacent property.

8. Disinfection: Disinfect the new potable water piping and existing potable water piping affected by Contractor's operations in accordance with AWWA C651.

3.4 FIELD TESTS AND INSPECTION:

9. General: The Engineer will conduct field inspections and witness all field tests specified in this Section. Perform all field tests, and provide all labor, equipment, and incidentals required for testing, including water and electrical power necessary for the tests. Approval will be by the Engineer. The Contractor shall produce evidence, when required, that any item of work has been constructed properly in accordance with the drawings and specifications.

   Tests shall be made prior to backfilling of trenches for buried pipe. Tests shall not be made until at least 5 days have elapsed since any concrete thrust blocks in the section have been poured. The pipe shall be filled with water and allowed to stand for a 24 hour period to permit absorption. Each valved section of pipe shall then be slowly filled with water to replace any lost by absorption. Test pressure shall be 150 psi minimum.

10. Testing Procedure: Testing procedure for water mains and water lines shall be in accordance with the appropriate AWWA Publications specified herein, except for the special test requirements given hereinafter.

    Testing procedure for water service lines shall be in accordance with the applicable requirements of AWWA C600. No leakage will be allowed at pipe joints.

11. Special Testing Requirements: Hydrostatic pressure for pressure test shall be 150 psi and shall be held for a period of not less than 2 hours. Prior to the pressure test that portion of the water line being tested shall be filled with water for a soaking period of not less than 24 hours.

    The test pressure shall be the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

4. Testing of Equipment and Control Devices: All equipment and control devices and appurtenances such as valves, etc., shall be tested in operation in a manner approved by the Engineer to demonstrate compliance with the contract requirements.

END OF SECTION 02713

SECTION 02720

STORM DRAINAGE SYSTEM

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: The latest issues of the following publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.2

A. Federal Specifications (Fed. Spec.):

RR-F-621D	Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole
TT-C-490C	Cleaning Methods and Pretreatment of Ferrous Surfaces for Organic Coatings
TT-P-645A	Primer, Paint, Zinc Chromate, Alkyd Type

B. Military Specification (Mil. Spec.):

MIL-P-15328C	Primer (Wash) Pretreatment, Blue & AM 1 (Formula No. 117-B for Metals)

C. American Concrete Institute (ACI) Publications:

ACI315	Details and Detailing of Concrete Reinforcement

D. American Society for Testing and Materials (ASTM) Publications:

C 150	Standard Specifications For Portland Cement
C478	Precast Reinforced Concrete Manhole Sections
D3033	Type PSP Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
D3034	Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings (REV B)
D 2444	Test Method for Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)

D 3212	Specification for Joints and Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
F 477	Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
F 949	Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with Smooth Interior and Fittings

1.2 DESCRIPTION OF WORK AND GENERAL REQUIREMENTS:

A. Storm Drainage System: Drainage system improvements include but not limited to the installation of drainage pipes and other appurtenances for a complete installation, as called for in the plans.

B. Related Sections:

Section 02050 - Demolition and Removal
Section 02201 - Earthwork for Utilities and Structures
Section 03300 - Cast-In-Place Concrete

C. Samples: Submit samples of the following materials for approval before work is started:

1. Pipes and Fittings

D. Layout Drawings: Submit drawings for layout of drainage systems. Indicate locations of fittings and other accessories on layout drawings. Do not begin excavation work until layout drawings have been approved by the Engineer.

E. Shop Drawings: Submit shop drawings for the following:

1. Concrete Reinforcement, in accordance with ACI 315
2. Precast concrete manholes
3. Metal Work

F. Manufacturer's Data: Submit manufacturer's standard drawings or catalog cuts of the following items:

1. Pipes
2. Fittings
3. Joints, Couplings and Gaskets

4. Oil Stop Valve
5. Frames, Covers, and Gratings

G. Manufacturer's Certificates of Conformance: Submit manufacturer's certificates of conformance or compliance for each of the following materials which are specified to conform to publications referenced under "Products" in this section:

1. Pipe and Fittings
2. Pipe Joint Materials
3. Oil Stop Valve
4. Frames, Covers, and Gratings

All tests required by each applicable referenced publication shall have been performed, whether specified in that publication to be mandatory or otherwise. For tests which are not specified in the referenced publications to be performed at definite intervals during manufacture, the tests shall have been performed within 3 years of the date of submittal of certificates on the same type, class, grade, and size of material as is being provided for the project.

1.3 DELIVERY, STORAGE, AND HANDLING OF MATERIALS:

A. Piping: Inspect materials delivered to the site for damage and store with a minimum of handling. Store materials on site in enclosures or under protective coverings. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

B. Cement: Store cement immediately upon receipt at site of work. Cement in ripped bags at the time of delivery shall be rejected. Store bagged cement and in a suitable waterproof structure which has been made as air-tight as practicable, and which has floors elevated at least 12 inches above ground to prevent absorption of moisture. At the time of use, cement and lime shall be free-flowing and free of lumps. Cement that has been in storage longer than 6 months shall be tested as deemed necessary to determine its suitability for use. Such cement or shall not be used without the approval of the Engineer.

C. Metal Items (Except Concrete Reinforcement): Check upon arrival; identify and segregate as to types, functions, and sizes. Store in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

D. Concrete Reinforcement: Store reinforcement in a manner that will avoid excessive rusting or coating with grease, oil, dirt, and other objectionable materials. Store in separate piles or racks so as to avoid confusion or loss of identification after bundles are

broken.

E. Handling: Handle pipe, fittings, and accessories in such a manner as to ensure delivery to the trench in sound undamaged condition.

5. Pre-cast Concrete Manholes: Handle precast manhole sections with care to avoid chipping and breakage; store as directed. Protect precast concrete from contact with the earth and exposure to weather; keep dry until used.

PART 2 - PRODUCTS

2.1 PIPING:

A. Pipe and Fittings:

Pipes and fittings shall be PVC conforming to ASTM D3034 with integral bell gasket joints or approved equal. Rubber gasket shall be factory installed and conform to ASTM F477.

Pipe shall be made of PVC plastic having a cell classification of 12454B or 12364B as defined in ASTM 1784 and shall have SDR of 35 and minimum pipe stiffness of 46 psi, according to ASTM test D2412.

Pipe perforations shall follow the ASTM D2729 perforation specifications of two rows of ½ inch diameter holes with hole spacing 5 inches on center. The rows of holes are shown on the plans.

B. Filter Fabric:

Filter fabric shall be Cultec #410 Fabric Interface or approved equal. The fabric shall have grab strength of not less than 90 lbs and elongation of 50% maximum. Flow rate capacity shall not be less than 175 gallons per minute per square foot area.

3. Oil Stop Valve:

Oil Stop Valve (OSV) shall have a design flow of not less than 600 gallons per minute (gpm). Its main function is to prevent the discharge of separated oil to storm sewer. The OSV shall have only one moving part, ballasted float set at a specific gravity between that of oil and water.

The OSV shall be fabricated from non-corrosive, PVC and stainless steel materials. The OSV operation requires no power.

4. PRECAST CONCRETE MANHOLE SECTIONS : Precast concrete manhole risers, base sections, and tops shall conform to ASTM C478. Precast manhole cones shall be suitable for use with 30-inch manhole frames and covers. Exterior of all manhole components shall be coated with two (2) coats of bituminous paint.

5. METAL ITEMS: Frames and Covers: Frames, covers, and gratings shall conform to Fed. Spec. RR-F-621 and shall be of cast iron as detailed in the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION OF DRAINAGE PIPE AND APPURTENANT CONSTRUCTION:

A. General Requirements for Installation: These requirements shall apply to all pipeline installations.

1. Earthwork: Do earthwork in accordance with Section 02201 entitled Earthwork for Utilities and Structures.

2. Pipe Bedding: A minimum of 6 inches thick, or as indicated, of the material specified in Subparagraph 2.1(A) of Section 02201 shall be placed below the bottom of the storm drainage pipe and compacted to 90% of the maximum density obtained at optimum moisture as determined by ASTM D1557, Method D. Trenches over excavated shall be backfilled and compacted with the same material required grade.

3. Up to subgrade above the pipe: The materials as specified in Subparagraph 2.1(B) of Section 02201, shall be used to fill the trench to a compacted depth of 12 inches minimum above the pipe which shall conform to the details provided on the drawings. The material shall be deposited in loose layers not exceeding 10 inches in thickness and compacted to 90 percent of the maximum density.

4. Pipe laying and Jointing: Each pipe and fitting will be inspected before and after installation and those found defective will be rejected. Provide proper facilities for lowering sections of pipe into trenches. Lay pipe with the bell to groove ends in the upgrade direction. Adjust spigots in bells and tongues in grooves to give a uniform space all around. Blocking or wedging between bells and spigots or tongues and grooves will not be permitted. Replace by one of the proper dimensions any pipe or fitting that does not allow sufficient space for proper caulking or installation of joint material. At the end of each day's work, close open ends of pipe temporarily with wood blocks or bulkheads.

3.2 CONCRETE WORK: Refer to Section 03300, entitled Cast-in-Place Concrete.

3.3 MANHOLE CONSTRUCTION: Construct base slab of cast-in-place concrete or use precast concrete base sections. Make inverts in cast-in-place concrete and precast concrete bases with a semi-circular bottom conforming to the inside contour of the adjacent inlet and outlet pipe sections. Shape inverts accurately and provides a smooth finish. For changes in direction of the drainage line and entering branches into the manhole, make a circular curve in the manhole invert of as large a radius as manhole size will permit.

3.4 METAL WORK: Workmanship and Finish: Perform metal work so that workmanship and finish will be equal to the best practice in modern structural shops and foundries. Form iron to shape and size with sharp lines and angles. Do shearing and punching so that clean true lines and surfaces are produced. Make castings sound and free from warp, cold shuts, and blow holes that may impair their strength or appearance.
Field Painting: After installation, clean cast-iron frames, covers, gratings, and steps not buried in masonry or concrete to bare metal of mortar, rust, grease, dirt, and other deleterious materials and give a coat of bituminous paint. Do not paint surfaces subject to abrasion.

3.5 RESTORATION TO EXISTING CONDITIONS: Existing road and drainage facilities and other improvements damaged or adversely affected by construction of drainage system improvements shall be restored to original or better conditions satisfactory to the Engineer.

3.6 FIELD TESTS AND INSPECTIONS:

A. Field tests and Inspections, General: The Engineer will conduct field inspections, if necessary. The Contractor shall perform all field tests, if required, to perform such test. The Contractor shall be able to produce evidence, when required, that any item of work has been constructed properly in accordance with the drawings and specifications.

B. Pipeline Testing: Check each straight run of pipeline for gross deficiencies by holding a light in an inlet or manhole (also called "lamping"); it shall show a practically full circle of light through the pipeline when viewed from the adjoining end of line. Alternative pipeline testing methods may be used subject to the review and written approval of the Engineer.

C. Leakage Tests: Not applicable.

D. Field Tests for Concrete: Field testing requirements are covered in Section 03300, entitled Cast-in-Place Concrete.

END OF SECTION 02720

SECTION 02724

OIL STOP VALVE

1.0 GENERAL

The section covers furnishing and installation of Oil Stop Valve (OSV) assembly.

Oil Stop Valve shall be CONTECH Model AFL-OSV-4SST or approved equal. The valve operates on a buoyancy principle. The ballasted float, which is the only moving part, is weighted for a specific gravity of 0.95. In the water, the float will float and keep the valve open. An accumulation of oil around the float will decrease the buoyant force on the float, causing it to float lower in the liquid. As the oil accumulation increases, the float will sink lower and finally close the valve when the oil is approximately 3 to 4 inches above the bottom of the float.

The design of Oil Stop Valve shall be for easy and efficient operation in confining oil spills to the premises. It is used in oil/water gravity differential separators, coalescing type separators and oil vaults to prevent the entry of oil into the effluent.

For the valve to function properly, a minimum water level, sufficient to completely submerge the float housing, will be required. Operating the valve with less than the minimum recommended water level will reduce the capacity of the OSV.

2.0 PRODUCTS

1. Valve: Fabricated control valve designed to control oil spills. Its main function is to prevent the discharged of separated oil to storm sewer. Valve assembly shall consist of a base, guides, inlet housing, float, and outlet connection. Valve shall be designed to operate on specific gravity differential principle.

2. Float: Ballasted float shall have a specific gravity of 0.95.

3. Flow: Valve capacity shall be 160 gpm (maximum) by gravity flow.

4. Inlet Pipe Size: Refer to drawing.

5. Outlet Pipe Size: Refer to drawing.

6. Vent: Vent shall be 1" SS threaded coupling is located on top of discharge pipe. Vent pipe to extend above maximum oil level. Vent material to be stainless steel pipe and to be supplied by the contractor.

7. Coupling: Coupling shall be 1" SST threaded coupling and plug located on the side of discharged pipe.

3.0 MATERIALS OF CONSTRUCTION

1. Base, Housing and Outlet Piping: 304 SST

2. Float: SST with Teflon Seat

3. Float Guides: Type304 Stainless Steel sleeves

4.0 DESIGN REQUIREMENTS

1. Pressure Rating: Atmospheric

2. Temperature: Ambient with 450°F maximum.

3. Capacity: 160 GPM (Maximum)

END OF SECTION 02724

SECTION 02831

CHAIN LINK FENCES

PART 1 - GENERAL

1.1 SUMMARY: Provide chain link fence system where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

1.2 APPLICABLE PUBLICATIONS: The latest issues of the following publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

A. American Society for Testing and Materials (ASTM)

A392	Standard Specification for zinc-coated Steel Chain-Link Fence Fabric.
D1187	Standard Specification for Asphalt-Base Emulsion for use as protective coating for metals.
F626	Standard Specification for Fence Fittings
F1083	Standard Specification for Pipe, Steel, Hot-dipped Zinc-Coated (Galvanized) Welded, for Fence Structures

1.3 RELATED SECTIONS

A. SECTION 02200 – EARTHWORK
B. SECTION 03300 - CAST-IN-PLACE CONCRETE

1.4 SUBMITTALS

A. Product data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:

1. Materials list of items proposed to be provided under this Section;

2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements;

3. Shop Drawings in sufficient detail to show fabrication, installation, anchorage, and

interface of the work of this Section with the work of adjacent trades;

4. Manufacturer's recommended installation procedures which, when approved by the Contractor, will become the basis for accepting or rejecting actual installation procedures used on the Work.

1.5 QUALITY ASSURANCE: Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.6 DELIVERY, STORAGE, AND HANDLING: Deliver materials to the site in an undamaged condition. Store materials off the ground to provide protection against oxidation caused by ground contact.

PART 2 - PRODUCTS

2.1 DIMENSIONAL DATA

A. General: Pipe sizes indicated are commercial pipe sizes.

2.2 GALVANIZING

A. On steel framework and appurtenances, provide galvanized finish with not less than the following weight of zinc per square feet.

1. Pipe: 1.8 oz/square foot, complying with ASTM F1083.

2. Hardware and accessories: Comply with Table I of ASTM F626.

3. Fabric: 1.20 oz/square foot, complying with Class 1 of ASTM A392.

2.3 FABRIC

A. Provide number 9 gage or 0.148" wires in 2" mesh, with top and bottom selvages twisted.

B. Provide fabric in one-piece widths.

2.4 POSTS, RAILS, AND ASSOCIATED ITEMS

A. End, corner, slope, and pull posts: Provide the following minimum sizes and weights as indicated on the plan.

Material and dimensions:	Lbs per linear ft:
Pipe, 2.87" outside Dimension	5.79
Pipe, 3.50" outside Dimension	7.58
Pipe, 4.00" outside Dimension	9.11

B. Line posts: Provide minimum sizes and weights as follows:

Material and dimensions:	Lbs per linear ft:
Pipe, 2.37" outside Dimension	3.65
Pipe, 2.87" outside Dimension	5.79
Pipe, 3.50" outside Dimension	7.58

C. Gate posts: Provide gate posts for supporting single gate leaf, or one leaf of a double gate installation, for nominal gate widths as follows:

Material and dimension:	Lbs per linear foot:
Pipe, 4" outside dimension	9.11

1. Over 13 feet wide, and up to 18 feet wide: Use 6.62" outside diameter pipe weighing 18.97 lbs per linear ft.

2. Over 18 feet side: Use 8.62" outside diameter pipe weighing 28.55 lbs per linear ft.

D. Top rails:

1. Use 1.90" outside diameter pipe weighing 2.72 lbs per linear ft; or

2. Provide in manufacturer's longest lengths, with expansion type couplings approximately 6" long for each joint.

3. Provide means for attaching top rail securely to each gate, corner, pull, slope, and end post.

E. Post brace assemblies:

1. Provide at end and gate posts, and at both sides of corner, slope, and pull posts, with the horizontal brace located at mid-height of the fabric.

2. Use 1.90" outside diameter pipe weighing 2.72 lbs per linear ft for horizontal brace.

3. Use 3/8" diameter rod with turnbuckle for diagonal truss.

F. Tension wire: Provide number 7 gage galvanized tension wire at bottom of fabric.

G. Post tops:

1. Provide steel, wrought iron, or malleable iron, designed as watertight closure cap.

2. Provide one cap for each post.

3. Provide caps with openings to permit through passage of top rail.

H. Stretcher bars:

1. Provide one-piece lengths equal to full height of fabric, with a minimum cross-section of 3/16" x 3/4".

2. Provide one stretcher bar for each gate and end post, and two for each corner, slope, and pull post, except where baric is woven integrally into the post.

I. Stretcher bar bands:

1. Provide steel, wrought iron, or malleable iron, spaced not over 15" on centers, to secure stretcher bars to end, corner, pull, slope, and gateposts, with a minimum cross-section of 1/8" x 3/4".

2. Bands may be used also with special fittings for securing rails to end, corner, pull, slope, and gateposts.

2.5 GATES

A. General:

1. Fabricate gate perimeter frames of tubular members.

2. Provide additional horizontal and vertical members to assure proper operation of the gate, and for attachment of fabric, hardware, and accessories.

3. Space so frame members are not more than 8 feet apart.

4. Fabricate gate frames from:

Material and dimensions:		Lbs per linear foot:
a.	Pipe 1.90" outside diameter:	2.72

B. Fabrication:

1. Assemble gate frames by welding with special malleable or pressed steel fittings and rivets for rigid connections.

2. Use same fabric as used in the fence.

3. Install fabric with stretcher bars at vertical edges as a minimum.

4. Attach stretchers to gate frame at not more than 15" on centers.

5. Attach hardware with rivets or by other means which will provide security against removal and breakage.

6. Provide diagonal cross bracing consisting of 3/8" diameter adjustable length truss rods on gates where required to provide frame rigidity without sag or twist.

C. Gate hardware: Provide following for each gate:

1. Hinges:

a. Pressed or forged steel, or malleable iron, to suit the gate size; non-lift-off type, offset to permit 180 degree opening.

b. Provide 1-1/2 pair of hinges for each leaf over 6 feet in nominal heights.

2. Latches:

a. Provide forked type or plunger-bar type to permit operation from either side

of the gate.

b. Provide padlock eye as integral part of latch.

3. Keeper: Provide keeper for vehicle gates, which automatically engages the gate leaf and holds it in the open position until manually released.

4. Double gates:

a. Provide gate stops for double gates consisting of mushroom or flush plate, with anchors.

b. Set in concrete to engage the center drop rod or plunger bar.

c. Provide locking device and padlock eyes as an integral part of the latch, requiring one padlock for locking both gate leaves.

2.6 MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Wire ties:

1. For tying fabric to line posts, use number 9-gage wire ties spaced 12" on centers.

2. For tying fabric to rails and braces, use number 9-gage wire ties spaced 24" on centers.

3. For tying fabric to tension wire, use number 9 gage hog rings spaced 24" on centers.

4. Manufacturer's standard wire ties will be acceptable if of equal strength and durability.

5. Concrete: Comply with provisions of Section 03300, entitled “Cast-in-Place Concrete”.

B. Bituminous Coatings: Fence post and hardwares embedded in concrete shall receive two (2) coats of bituminous material as per ASTM D1187.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS: Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. General:

1. Install posts at a maximum spacing of 10 feet on centers.

2. Install corner or slope posts where changes in line or grade exceed a 30-degree deflection.

B. Excavating:

1. Drill holes for post footings in firm, undisturbed or compacted soil, strictly adhering to the dimensions and spacing shown.

2. Post hole dimensions:(unless otherwise specified)

a. Provide 30" deep by 12" diameter foundations for line posts for 5 foot fabric height and less.

b. Provide 36" deep by 12" diameter foundations for line posts for fabric heights exceeding 5 feet.

c. Provide 42" deep by 12" diameter foundations for all other posts or as specified on plan.

C. Spread soil from excavations uniformly adjacent to the fence line, or on adjacent areas of the site if so directed.

D. When solid rock is encountered near the surface, drill into rock at least 12" for line posts and at least 18" for end, pull, gate, and corner posts. Drill hole at least 1" greater diameter than the largest dimension of the post to be placed.

E. If solid rock is below soil overburden, drill to full depth required, except penetration into rock need not exceed minimum depths specified above.

F. Setting posts:

1. Remove loose and foreign materials from sides and bottoms of holes, and moisten soil prior to placing concrete.

2. Center and align posts in holes.

3. Place concrete around posts in a continuous pour, and vibrate or tamp for consolidation.

4. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.

5. Trowel tops of footings, and slope or dome to direct water away from posts.

6. Extend footings for gateposts to the underside of bottom hinge.

7. Set keepers, stops, sleeves, and other accessories into concrete as required.

8. Keep exposed concrete surfaces moist for at least seven days after placement, or cure with membrane curing material or other curing method approved by the Engineer.

9. Grout-in those posts that are set into sleeved holes, concrete constructions, or rock excavations, using non-shrink Portland cement grout or other grouting material approved by the Engineer.

G. Concrete strength:

1. Allow concrete to attain at least 75% of its minimum 28-day strength before rails, tension wires, and/or fabric is installed.

2. Do not, in any case, install such items in less than seven days after placement of concrete.

3. Do not stretch and tension fabric and wire, and do not hang gates, until concrete has attained its full design strength.

H. Rails and bracing:

1. Install fence with a top rail and bottom tension wire.

2. Install top rails continuously through post caps or extension arms, bending to radius for curved runs.

3. Provide expansion couplings as recommended by the fencing manufacturer.

4. Provide bracing to the midpoint of the nearest line post or posts at all end, corner,

slope, pull, and gateposts.

5. Install tension wires parallel to the line of fabric by weaving through the fabric, and tying to each post with not less than number 6 gage galvanized wire, or by securing the wire to the fabric.

I. Installing fabric:

1. Leave approximately 2" between finish grade and bottom selvage.

2. Excavate high points in the ground to clear the bottom of the fence.

3. Place and compact fill to within 1" of the bottom of the fabric in depressions.

4. Pull fabric taut and tie to posts, rails, and tension wires.

5. Install fabric on outward side facing side of fence, and anchor to framework so that the fabric remains in tension after pulling force is removed.

6. Install stretcher bars by threading through or clamping to fabric on 4" centers, and secure to posts with metal bands spaced 15" on centers.

7. Install fence fabric to provide approximately 2-inch deflection at center of fabric span between two posts, when a force of approximately 30 pounds is applied perpendicular to the fabric. Fabric should return to its original position when force is removed.

J. Installing gates:

1. Install gates plumb, level, and secure for full opening without interference.

2. Install ground-set items in concrete for anchorage in accordance with the fence manufacturer's recommendations as approved by the Engineer.

3. Lubricate and adjust the hardware for smooth operation.

K. Clearing Fence Line: All trees, brush, stumps, logs, and other debris which would interfere with the proper construction of the fence in the indicated locations shall be removed to a minimum width of 5 feet on each side of the fence centerline before starting fencing operations. The cost of removing and disposing of the materials shall not constitute a pay item but shall be considered incidental to the fence construction.

L. Miscellaneous:

1. Use U-shaped tie wires, conforming to diameter of pipe to which attached, clasping pipe and fabric firmly with ends twisted at least two full turns.

2. Bend ends of wire to minimize hazards to persons and clothing.

3. Fasteners:

   a. Install nuts for tension band and hardware bolts on side of fence opposite fabric side.

   b. Peen the ends of bolts to prevent removal of nuts.

4. Repair coatings damaged in the shop or field erection, using a hot-applied repair compound applied in accordance with its manufacturer's recommendations as approved by the Engineer.

END OF SECTION 02831

SECTION 03100

CONCRETE FORMWORK

PART 1 GENERAL

1.1 WORK INCLUDED

a. Provide formwork construction for all cast-in-place concrete.

b. Install built-in anchors, inserts and bolts for connection of other materials.

c. Install built-in frames and all other embedded items.

1.2 QUALITY ASSURANCE

a. Design Criteria:

(1) General: Conform to ACI 347, Chapter 2, "Design".

(2) Plywood: Conform to tables for form design in APA Form V345, including strength characteristics.

b. Allowable Tolerances:

(1) Variation from plumb in lines and surfaces of walls and arises shall not exceed 1/8" in 10 feet with maximum "in" and "out" variation occurring in not less than 20 feet.

(2) Variations in linear building lines from established position in plan and related position of columns, piers, or walls shall not exceed 1/4" in any bay of 20 feet or 1/2" in 40 feet. Variation shall not exceed 1/2" for any length.

(3) Variation in cross sectional dimension of columns and beam and thickness of slabs and walls shall not exceed minus 1/4" or plus 1/2".

(4) Deflection of beams, soffits of openings, and structural slabs shall not exceed 1/8" for their entire length.

c. Codes and standards:

(1) Materials: Comply with ACI 347, Chapter 4.

(2) Grading and Dressing Rules: WCLB No. 16.
(3) Plywood: Product Standard PS1.

1.3 SUBMITTALS

a. Product data: Submit manufacturer's literature for:

(1) Form ties and spreaders.

(2) Form coating.

PART 2 PRODUCTS

2.1 MATERIALS

a. Earth forms: May be used for footings only where the soil is firm and stable and the concrete will not be exposed. Where earth forms are used, make excavations neat and accurate to size for placing of concrete directly against the excavation.

b. Lumber: Light framing or studs for forms: 2" to 4" and larger in nominal width and thickness.

c. Plywood: Plyform, B-B grade, Class I or II (exterior), 5/8" thick minimum.

d. Chamfer Strips: Type CST 3/4 (3/4" diagonal face), or equivalent.

e. Ties: Carbon steel tie rods with a breakback depth of 1", and a maximum cone diameter of 1-1/4".

f. Metal construction joints: Keyed-kold, by Burke Concrete Accessories, or approved equivalent.

g. Waterstops: Extruded "dumbell" type, tensile strength equal to concrete design strength. Splice by thermal butt fusion. Waterstop shall be rated for oil containment facilities. Provide one of the following:

(1) Servicised/Durajoint by Construction Productions Div. of W. R. Grace & Co.

(2) BFG Vinyl waterstops by B. F. Goodrich Industrial products.

(3) Sealtite by W. R. Meadows, Inc.

(4) Greestreak waterstops by Greenstreak Plastic Products.

h. Form Coatings: Use only non-staining, clear coatings which do not contain oil or wax, and will not prevent proper adhesion of applied finishes. Provide one of the following:

(1) Formshield, by A. C. Horn, Inc.

(2) Release, by Burke Concrete Accessories.

(3) Magic Kote, by Symons.

i. Pressure sensitive tape: 3M or equivalent polyurethane or mylar faced adhesive backed tape. Use for formwork joints in all exposed to view concrete.

j. Form anchors and hangers: Anchors and hangers used for exposed concrete shall not leave exposed metal at surfaces. Arrange hangers supporting forms from structural steel symmetrically on supporting members to minimize twisting or rotation of member. Penetration of structural steel members will not be permitted.

PART 3 EXECUTION

3.1 DESIGN

a. Formwork design for all concrete structures shall be in accordance with all applicable code requirements.

b. Coordinate design, construction and placement with all other trades and contractors.

c. Design formwork in such a manner that when erected and braced, it will safely support vertical, lateral, static and dynamic loads that might be applied, until such loads can be supported by the concrete structure. Design formwork so that all loads on formwork will be transferred to the ground or to in-place construction that has attained adequate strength to support the applied loads.

d. Design forms and falsework to include assumed values of live load, dead load, and weight of moving equipment operated on formwork, concrete mix, height of concrete drop, vibrator, frequency, rate of placement, foundation pressures, stresses, lateral stability and other factors pertinent to safety of structure during construction.

e. Design shores and struts with positive method of adjustment; capable of taking up formwork settlement during concrete placing operations, using wedges or jacks, or a combination of both.

f. Design structural members to support form facing materials without deflection.

g. Provide design for temporary openings in wall forms, column forms and at other locations necessary to permit inspection and clean-out.

h. Design formwork so that it will be readily removeable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials.

i. Design formwork so it will be sufficiently tight to prevent leakage during concrete placement.

3.2 EARTH FORMS

a. Earth forms: Trench earth forms at least 2" wider than footing widths shown on Drawings. Construct wood edge strips at each side of trench at top to secure reinforcing and prevent trench from sloughing. Form sides of footings where earth sloughs. Firmly tamp earth forms and remove all debris and loose material before depositing concrete.

3.3 FORM CONSTRUCTION

a. General: Conform to ACI 347 recommendations. Construct forms as required to obtain exact size, shape, line level alignment, location, elevation and grades indicated on Drawings.

b. Provide for openings, offsets, sinkages, keyways, recesses, moldings, reglects, chamfers, blocking, screeds, bulkhead, anchorages and inserts, and other features indicated or required for work of other trades.

c. Fabricate forms for easy removal without hammering or prying against concrete surfaces.

d. Form intersecting planes to provide true, clean-cut corners, without exposing edge grain of plywood on finish concrete.

e. Forms for exposed concrete:

(1) Drill holes in forms to fit ties used. Do not drive through undersized or improperly

prepared holes.

(2) Do not use metal cover plates for patching holes or defects in forms.

(3) Provide sharp, clean corners at intersection planes, without visible edges or offsets. Back joints with extra studs or girts to maintain true, square intersections.

(4) Use extra studs, walers and bracing as required to prevent bowing or pillowing of forms between studs.

(5) Form molding shapes, recesses and projections with smooth finishes materials, and install in forms with sealed joints to joints to prevent displacement.

(6) Finish all joints with specified tape to provide smooth surfaces for all exposed concrete.

f. Corner treatment:

(1) Except where otherwise indicated on Drawings, form exposed between beams and columns in a manner to produce square, smooth, solid, tight fitting joints.

(2) Where detailed on Drawings, provide a chamfer on all exposed corners using specified strips. Miter chamfer strips at all changes in direction.

g. Provision for other trades:

(1) Accurately place and securely support items which are built into forms.

(2) Size and location of openings, recesses and chases are the responsibility of the trade requiring such items.

h. Cleaning and tightening:

(1) Thoroughly clean forms and remove chips, wood, sawdust, dirt and other debris just prior to concrete placement.

(2) Retighten forms during or immediately after concrete placement as may be required to eliminate any leakage.

i. Waterstops:

(1) Install accurately in the formwork. Securely fasten in place in accord with

manufacturer's instructions.

(2) Provide maximum manufactured lengths to avoid joints.

(3) Thermally weld joints and intersections in accord with manufacturer's instructions. Joints shall develop 85% (minimum) of the tensile strength of the section.

3.4 FORM COATINGS

a. Coat form contact surfaces with specified coating compound before reinforcement is placed. Do not permit excess form coating material to accumulate in the forms or to come in contact with surfaces which will be embedded in concrete. Apply in accord with manufacturer's instructions.

3.5 EMBEDDED ITEMS

a. General: Set and build into formwork all sleeves, anchorage devices and other embedded items required for the work that is attached to, or supported by cast-in-place concrete.

b. Use setting drawings, diagrams, instructions and directions provided by suppliers of the items to be attached thereto.

c. Edge forms and screed strips for slabs:

(1) Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in the finished slab surfaces.

(2) Provide and secure units to support types of screeds required.

(3) Provide cradle, pad or base type screed supports when required, for concrete over vapor-barrier membranes. Staking through the membrane will not be permitted.

3.6 SHORES AND FALSE WORK

a. Comply with ACI 347, Article 3.7, and is herein specified.

b. Contractor shall be fully responsible for the proper strength, safety and adequacy of all falsework, supports, posts, and footing, used on and in connection with the work.

c. False work and supports shall be adequate in size and strength to resist the loads

imposed upon them without deformation, deflection, or settlement. Use wedges in pairs or jacks where required to bring forms, shoring, or falsework for beams, girders, slabs and other parts of the structure to the exact elevations and uniform bearing before placing concrete.

d. Single wedges will not be permitted. Vertical and lateral loads shall be carried to ground by form work system or by completed structure, after it has attained adequate strength. Construct forms to permit their removal without disturbing the original shoring.

e. Design shoring of adequate strength and place so that the load from successive parts of the structure is transmitted directly through the falsework without creating bending or shearing stresses in the concrete.

3.7 DEFECTIVE WORK

a. Any movement of bellying of forms during construction or variations in excess of the tolerances specified will be considered just cause for the removal of such forms and the concrete work so affected. Reconstruction of forms and providing new concrete and reinforcing work shall be performed at no additional cost to the Owner.

3.8 REMOVAL OF FORMS AND SHORES

a. General: Formwork not supporting concrete such as sides of beams, walls, columns, and similar parts of the work, may be removed after concrete has hardened sufficiently to maintain its integrity and not be damaged by form removal operations, but not less than four days. Initiate and maintain curing and protection of concrete immediately after stripping of forms.

b. Do not remove supporting forms and shoring until the members have attained sufficient strength to support their weight and all superimposed loads safely. In no case may forms or shoring be removed until the time and sequence has been approved by the Engineer. Earlier removal than specified below may be approved by the Architect, based on the weather and test of cured cylinders.

c. Minimum time for forms and shoring to remain in place shall be as follows (expressed in days):

		FORMS	SHORING
(1)	Structural slabs and beams:	7	28

(2)	Soffits of openings in walls:	7	28
(3)	Walls, columns, and beam sides	7	10
(4)	Slabs on grade and sides of footings:	3	5

d. Do not use metal pinch bars when removing plywood forms. Use special care in stripping. Start at top edge or vertical corner and insert wooden wedges. Perform wedging gradually; lightly tap on plywood panels to crack them loose. Do not remove forms with a jerking motion.

e. Low forms to remain in place as long as possible to permit shrinkage away from concrete; leave plywood forms in place until all other forms around are stripped and until there is no danger of damaging the architectural concrete.

END OF SECTION 03100

SECTION 03200

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 WORK INCLUDED

a. Furnish and place all reinforcing steel for cast-in-place concrete.

1.2 QUALITY ASSURANCE

a. Allowable tolerances:

(1) Splices: Lapped splices, where indicated on Drawings, shall be adequate to transfer stress by bond. Unless otherwise noted on Drawings, lap bars a minimum of 30 diameters, but in no case less than 12". Wherever possible, stagger splices in adjacent bars.

(2) Concrete covering: Except where noted otherwise on Drawings, provide not less than the following concrete coverage for steel:

(a) Concrete against earth forms:	3 inches
(b) Over column ties:	2 inches
(c) Formed walls (below grade):	2 inches
(d) Formed walls (above grade):	1-1/2 inch (interior) 1-1/2 inch (exterior)
(e) Over beam stirrups:	2 inches

b. Codes and standards: Except as otherwise specified, comply with the following:

(1) International Building Code, 2009 Edition.

(2) CRSI: Reinforced Concrete, Manual of Standard Practice.

(3) CRSI: Recommended Practice for Placing Reinforcing Bars.

(4) CRSI: Recommended Practice for Placing Bar Supports.

(5) ACI 315: Manual of Standard Practice for Detailing Reinforced Concrete Structures.
(6) ACI 318: Building Code Requirements for Reinforced Concrete.

1.3 SUBMITTALS

a. Prior to delivery of steel to project, submit mill affidavits, stating the grades and physical and chemical properties of the reinforcing steel, and conformance with Specifications.

b. Shop drawings: Submit detailed fabrication, bending and placement drawings and schedules for all reinforcing steel for structural slabs, walls, beams and columns. Indicate all sizes and locations. Include pertinent data required for the fabrication and placement.

1.4 PRODUCT HANDLING

a. Protect steel at all times from distortion, moisture, dirt, grease, and all contaminants which will impair bonding to concrete.

b. Maintain a sufficient supply of approved reinforcing steel stored on the site at all times to avoid any delay in the progress of the work. Maintain identification of steel after bundles are broken.

c. Deliver bars new and free from rust and mill scale, in original bundles with mill tags intact.

d. Bundle and tag reinforcing steel, with grades and suitable identification marks for verification, sorting, and placing. Provide waterproof tags and markings. Do not remove until steel is placed.

PART 2 PRODUCTS

2.1 MATERIALS

a. Reinforcing bars: ASTM A615, Grade 60, deformed, billet steel bars (Minimum yield strength; 60,000 psi).

b. Welded wire fabric: ASTM A185, welded steel wire fabric. Gauge and center-to-center spacing as noted on Drawings. Minimum yield strength 65,000 psi.

c. Accessories: Provide spacers, chairs, ties, and similar items as required for proper spacing, assembling, and supporting reinforcement in place. Provide galvanized steel or approved

plastic conforming to CRSI standards.

d. Tie wire: ASTM A82, #16 gauge, or heavier where noted or specified; black or galvanized steel wire.

2.2 FABRICATIONS

a. Fabricate steel reinforcement as indicated on the Drawings and the approved shop drawings. Where specific details are not shown or noted, comply with the applicable requirements of the referenced standards.

b. Cut and bend bars accurately, and place as indicated on the Drawings. Bend bars cold; heating of bars will not be allowed. Do not bend or straighten bars in any manner that will injure the material.

PART 3 EXECUTION

3.1 INSPECTION

a. Examine surfaces for conditions that will adversely affect execution, permeance and quality of the work. Correct unsatisfactory conditions before proceeding with placing reinforcing steel.

3.2 ERECTION

a. General: Place reinforcing steel in accord with the Drawings and approved shop drawings, and the applicable referenced Codes and Standards. Install reinforcement accurately and secure against all movement.

b. Supports: Support bars on metal chairs or spacers on metal hangers; place accurately, and securely fasten to steel reinforcement. Provide additional bars, whether specifically shown on the Drawings or not, where necessary to securely fasten reinforcement in place.

(1) Support accessory legs in forms without embedding in form surface. Space chairs and accessories in accord with CRSI recommendations. Place hooping and stirrups accurately spaced and wired to reinforcing. No wood will be permitted inside forms.

c. Placing and tying: Set all reinforcing in place, space, and rigidly and securely wire tie at all splices, and at all crossing points and intersections in positions shown. Rebending of bars to fit existing conditions will not be permitted. Point ends of wire ties away from forms.

d. Spacing: Minimum center to center distance between parallel bars shall be as noted on Drawings; where not shown, the clear spacing shall be 2 times the bar diameter, but in no

case less than 1-1/2", nor less than 1-1/3 times the maximum size aggregate.

e. Splices: Laps of splices, where shown or noted on Drawings shall be adequate to transfer stress by bond. Unless shown otherwise, lap bars a minimum of 30 diameters, but in no case less than 12". Where possible, stagger splices in adjacent bars.

f. Welded wire fabric: Provide wire fabric in longest lengths as practicable; wire tie all laps and splices. Laps shall be 12". Off-set end laps in adjacent widths.

3.3 ADJUSTMENT

a. Provide trained steel workmen on the work at all times during the placing of concrete to properly reset all displaced reinforcement.

3.4 DEFECTIVE REINFORCING STEEL

a. The following reinforcing steel work will be considered defective, and the Engineer may order removal of such work, and require replacement by the Contractor at no additional cost to the Owner.

(1) Bars with kinks or bends not shown on drawings.

(2) Bars injured due to bending or straightening.

(3) Bars heated for bending.

(4) Reinforcement not placed in accordance with the Contract Documents.

END OF SECTION 03200

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 WORK INCLUDED

a. Cast-in-place concrete including all site concrete work indicated on Drawings.

b. Control joints.

1.2 QUALITY ASSURANCE

a. Codes and standards: Except as otherwise specified, or indicated on the Drawings, all work shall conform to the following, as applicable:

(1) International Building Code, 2009 Edition.

(2) ACI 318, Building Code Requirements for Reinforced Concrete.

(3) Ready-mix concrete: Mix and deliver in accord with ASTM C94 and the International Building Code – Chapter 19.

b. Allowable tolerances:

(1) Slab levels: Finish all surfaces true to 1/4" in 10 ft., verified with a straight-edge in any direction with maximum height and low variance occurring in not less than 20 feet and with 1/16" maximum tolerance in any one running foot.

(2) Vertical surfaces: In accord with ACI 347.

1.3 SUBMITTALS

a. Test reports: Contractor shall name the laboratory he proposed to employ, and request Engineer’s approval before commencing concrete work. Contractor may submit mill tests and manufacturer's certification of compliance with ASTM specifications in lieu of testing of cement and aggregate analysis.

b. Mix designs: Submit mix designs to the Engineer for approval.

1.4 PRODUCT HANDLING

a. Delivery: Arrange delivery so that intervals between batches are kept to a minimum, and in any event not more than thirty minutes. Do not add water during transit or at the job site without the Architect's approval.

b. Concrete shall be placed within 90 minutes after cement had been mixed with aggregate or 45 minutes after addition of water.

1.5 PROJECT CONDITIONS

a. Maximum placing temperature of the concrete, when deposited, shall be 90 degrees Fahrenheit. If weather causes the placing temperature to exceed 90 degrees Fahrenheit, mix may be cooled by wetting the aggregate or other appropriate method as approved by the Engineer.

1.6 TESTS

a. Concrete compression tests shall be performed by a qualified testing laboratory approved by the Architect.

b. Make one set of at least three cylinders in accord with ASTM C31 from each 50 cu. yds. of concrete or fraction thereof placed each day. Mark all cylinders in a set with a number on one end. Contractor shall record the number on his record on concrete placed. Cure the first and second cylinders at the job site under field conditions. Submit reports of all tests conducted by testing laboratory to the Engineer and Owner promptly on completion of such tests.

c. Test one cylinder from each set at 7-days and a second at 28-day in accord with ASTM C39. Retain the third cylinder from each set at the site until the 28-day test report on the second cylinder in the same set has been received by the Engineer. If this report is satisfactory, remove and dispose of the third cylinder. In the event, the second cylinder tests are below the required strength, the laboratory shall test the third cylinder at the age selected by the Engineer.

e. In the event compressive strength of the third cylinder, when tested, is below the specified minimum, the Engineer may require test cores of the hardened structure to be taken in accord with ASTM C42. If such test indicates that the core specimen is below the required strength, the concrete in question shall be removed and replaced without cost to the Owner.

f. Replace all work damaged as a result of concrete removal with new materials as directed by the Engineer at no additional cost to the Owner.

g. Core cylinders which have been taken by the testing laboratory, and the concrete proves to be satisfactory, shall have the cutout sections restored to their original condition in a manner acceptable to the Engineer as part of the work of this Section.

h. Slump test: Testing laboratory will make slump tests of concrete during concrete placing in accord with ASTM C143.

PART 2 PRODUCTS

2.1 MATERIALS

a. Portland cement: ASTM C150, Type I or II, or JSI R 5210. Use only one brand of cement on the project.

b. Aggregates: Manufacture from Coralline Limestone having a bulk specific gravity (SSD) of not less than 2.40 and shall conform to ASTM C33, except as modified herein. Aggregates shall be free from any substance which may be deleteriously reactive with the alkalies in the cement in an amount sufficient to cause excessive expansion of the concrete. Test shall conform to the method of potential reactivity of cement-aggregate combinations (mortar bar method) in accord with ASTM C227. Aggregates shall be washed before use.

c. Fine aggregates: Unless otherwise approved, fine aggregates from different sources of supply shall not be mixed or stored in the same stockpile, or used alternately in the same structure. Fineness modulus shall be defined according to ASTM C125.

(1) Aggregate which shows a variation in fineness modulus greater than 0.20 more or less than that of the representative sample submitted shall be rejected. Fine aggregate shall be graded according to the following table:

Sieve	Percentage Passing
3/8"	100
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 60
No. 50	10 to 30

No. 100	2 to 10
No. 200	0 to 5

(2) Coarse aggregates: The abrasion loss of coarse aggregates shall not extend 40% when tested in accord with ASTM C131. Grading of coarse aggregate shall be in accord with the following table:

Size of Coarse Aggregate (Inches)	Percentage by Weight Passing Sieves							
	1-1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16
1	100	90-100	---	25-60	---	0-10	0-5	---
3/4		100	90-100	---	20-55	0-10	0-5	---
½			100	90-100	40-70	0-15	0-5	---
3/8				100	85-100	10-30	0-10	0-5

d. Admixture: Use only when approved by the Engineer, and included in the design mix.

e. Water: Clean and potable, free of impurities detrimental to concrete.

f. Curing compound: Comply with ASTM C309, Type I.

g. Expansion Joint Filler: Premolded, of sizes and thicknesses shown on drawings, conforming to ASTM C1751.

h. Expansion joint sealing compound: Cold-applied poured latex rubber type sealant, conforming to ASTM 31850.

i. Expansion/contraction joints: ASTM D 994 preformed T & G type.

j. Non-Shrink Grout for Setting Metal Items. Use "EMBECO 636" premixed, nonshrink grout manufactured by Master Builders Company, "Ferrolith G.D.S." Redi-mixed, nonshrink grout manufactured by Sonneborn Building Products, Inc., or "Crystex" ready-mixed grout manufactured by L and M Construction Chemicals, Omaha, Nebraska.

k. Floor Hardener. Use "Lapidolith" manufactured by Sonneborn Building Products, Inc., "Saniseal No. 100" manufactured by Master Builders "Filpor" manufactured by West Chemical Products, or "Chem Hard" manufactured by L and M Construction Chemicals, Inc. Where no floor coverings are indicated in the schedule of finishes, treat concrete

floors with hardener. Apply hardener strictly in accordance with manufacturer's print directions. Where hardener is used, accomplish curing of concrete by means other than membrane forming compound.

l. Bonding Agents. Use Epoxy-Polysulphide; Colma Dur by Sika; 15J by Sta-Crete Inc.; Thiopoxy 62 by Grace Construction, or approved equal.

2.2 MIX DESIGN

a. Provide concrete mix designs for each class of concrete. Include recommended amounts of admixtures and water to be used in the mixes.

b. Provide concrete which will develop ultimate compressive strength at 28 days equal to that specified for the various elements of work.

2.3 CONCRETE STRENGTHS AND PROPORTIONS

a. Concrete shall have the maximum water-cement ratio of 0.5 and the following minimum compressive strengths at 28 days and shall be proportioned within the following limits:

Location	Minimum psi at 28 days	Maximum size of Aggregate Per C.Y.	Minimum sacks cement	Maximum Slumps
Slab on grade, Foundation	3000	1 in.	5.00	4 in.
Walls, columns, beams, topping on slabs, suspended slabs	4000	3/4 in.	5.50	4-5in.
All Others	3000	1 in.	5.00	4 in.

b. Exact proportions for mix, including amounts of admixture (if any) and water, shall be determined by the Contractor and subject to the Engineer’s approval.

c. If greater amounts of cement than the minimum amounts specified above are required

because the minimum strengths specified cannot be achieved with the minimum cement amounts specified, or are required because of Contractor's operations, such as pumping concrete, no increase in the Contract amount will be permitted. No lesser amounts of cement than the minimum amounts specified will be permitted for any reason.

d. Cost of obtaining the mix designs shall be paid by the Contractor.

(1) All concrete shall be ready-mixed concrete, mixed and delivered in accord with the ASTM C94, and the International Building Code - Chapter 19.

PART 3 EXECUTION

3.1 INSPECTION

a. Examine surfaces for conditions that will adversely affect execution, permanence and quality of the work.

b. Correct all unsatisfactory conditions before placing any concrete.

3.2 BUILDING PAD

a. Cover prepared building pad with compacted crushed coral aggregate base as indicated on the drawings.

3.3 PREPARATION

a. Forms: Before placing concrete, inspect forms thoroughly. Remove all chips, dirt, etc. Remove all temporary bracing and cleats; box all openings for pipes, etc,; secure all forms properly in their correct position and make tight. Secure all reinforcements, anchors, and embedded items in their proper places.

(1) Remove all set and dried concrete which is on forms and reinforcement; clean form surfaces and reinforcing before proceeding. Remove excess water and all foreign matter from forms and excavations.

(2) Unless otherwise directed, sand or sandy loam shall be moist but not saturated just prior to placing concrete.

b. Anchors and embedded items: Accurately secure all anchors, bolts, sleeves, inserts, wood blocking, and other items to be embedded in concrete in correct position before

placing concrete.

c. Notification: Notify the Engineer at least 72 hours in advance of placing any concrete.

d. Soil bottoms for footings and slabs shall be approved by the laboratory before placing concrete.

3.4 CONVEYING AND PLACING CONCRETE

a. Placing concrete:

(1) Before placing any concrete in formwork, thoroughly clean and wash-out forms with water.

(2) If earth at bottom of forms has dried-out, rewet so that soil is moist, but free of standing water and mud.

(3) Convey concrete from mixer to final position by methods which will prevent separation or loss of materials.

(4) Maximum height of concrete free fall shall not exceed 4 feet.

(5) Regulate rate of placement so concrete surface is kept level throughout; a minimum being permitted to flow from one area to another. Use tremie heads; space heads at approximately 10 foot intervals for placing concrete in walls. Control rate of pour consistent with form design.

(6) Deposit concrete in continuous operation until section being placed has been completed.

(7) Lift fabric to proper position during placement of concrete.

(8) Do not deposit partially hardened concrete in the work. Begin discharge of concrete not more than 45 minutes after the introduction of mixing water. Placing of concrete shall be completed within 90 minutes of the first introduction of water into the mix.

(9) Pumping: Concrete may be placed by pumping if approved in writing by the Engineer. Equipment for pumping shall be of such size and design as to insure a practically continuous flow of concrete at the delivery end without separation of materials. Concrete design mix shall be as approved for project use, except that mix may be richer in lubricating components to allow proper pumping.

b. Consolidating concrete:

(1) Use mechanical vibrating equipment for consolidation. Provide an adequate number of operating vibrator units at the pour area to consolidate the quantity of concrete to be placed, including spares for emergency use.

(2) Vertically insert and remove hand-held vibrators at points 18" to 30" apart. Vibrate concrete the minimum amount required for consolidation and release of entrapped air bubble.

(3) Do not use vibrators to transport concrete in forms.

(4) Do not continue vibration at one spot to the extent that large areas of grout are formed, or the heavier aggregates are caused to settle. Take care not to disturb concrete which has its initial set. Vibrators shall not be lowered deeper than the layer placed.

c. Construction joints:

(1) On completion of formed pour, strike concrete smooth at top of formwork, and prepare construction joints to receive next pour by removing entire surface paste to expose aggregates.

(2) On completion of a slab pour which will receive subsequent topping or additional concrete, expose aggregate in top surface by brooming in two directions at right angles to each other.

(3) Before depositing fresh concrete against or upon hardened concrete, sandblast surfaces to remove all incrustations and laitance; expose firmly embedded, clean coarse aggregate in mortar mix.

(4) At construction joints, dampen and slush surfaces which will receive fresh concrete, with neat cement grout slurry.

(5) Make construction joints in exposed surfaces only at pre-approved locations.

(6) Joints not indicated on the Drawings shall be made and located so as not to impair the strength of the structure.

3.5 EXPANSION JOINTS

a. Provide premolded expansion joints to full depth of slabs where indicated on Drawings. Install with top edge 1/2" below the surface; tool adjacent concrete edges to a 1/8" radius. Use steel pins to hold material in place during placing and floating of concrete.

b. After 28 days (minimum), after slabs have been placed and finished, fill tops of expansion joints with sealer to 1/8" below surface of slabs. Do not permit traffic to travel over sealed joints until sealer has fully cured.

3.6 PATCHING

a. Immediately after stripping forms, patch minor defects, form-tie holes, honey-combed areas, etc.

b. Remove ledges and bulges. Repair gravel pockets by cutting out to solid surface, form key, and thoroughly wet before placing patching mortar.

(1) Patching mortar shall consist of 1 part cement to 2 parts fine sand; compact into place and finish to exactly match surface texture.

c. Grind or fill surfaces to produce level, true planes. Patch honeycombed areas and gravel pockets which in the Engineer's opinion are too large for proper mortar patching; cut out to solid surface, key and pack solid with matching concrete to produce firm bond and surface. Patching shall match adjacent surfaces.

3.7 FINISHING FORMED SURFACES

a. Finish all surfaces of formed concrete which will remain exposed in the finished work, both interior and exterior, including surfaces which will be painted. Provide surfaces uniform for the intended texture; free from imperfect joints, fins, "honeyCombing", air pockets or "bug" holes, or other such imperfections.

b. Remove rough spots, stains and hardened mortar or grout from intended smooth surfaces by rubbing lightly with fine carborundum stone. Use liberal amounts of water, and rub sufficiently to remove defects without changing concrete texture.

c. If intended smooth surfaces are not of uniform texture, treat as follows:

(1) Prepare a mix consisting of one-part portland cement and 1-1/2 parts fine sand, and sufficient water to produce a grout of thick paint consistency.

(2) Wet surface to be treated, and apply grout uniformly with a brush, fill all air holes. Immediately float, scouring the surface vigorously. Allow grout to partially set for an hour or two, depending on weather conditions.

(3) When grout has sufficient hardened, so it can be scraped from surface with the edge of a steel trowel without removing grout from smaller air holes, cut-off all that can be removed with a trowel, allow surface to dry thoroughly, then rub with burlap to completely remove surplus.

(4) Further finish exposed intended smooth surfaces, if necessary, by means of honing with carborundum stone to uniform surfaces as directed by the Engineer.

(5) Complete entire operation for any area the day it is started.

(6) Do not use dry cement sacking.

3.8 FINISHING FLAT WORK

a. Tamp freshly placed concrete with approved metal grid tampers; bring fines to top, and rod to uniform surfaces at required levels.

(1) Float and trowel finish as soon as surfaces becomes workable.

(2) Provide slopes as indicated on Drawings.

b. Provide fog-spray equipment for use during finished to maintain adequate surface moisture and reduce plastic shrinkage. Use frequent light applications of moisture rather than excessive wetting. Temperature, humidity and wind conditions will dictate the amount of spray required for proper control.

3.9 CONCRETE SURFACES FINISHES

a. Fine float finish: Use for surfaces which will be covered by resilient floor covering or carpet.

b. Steel trowel finish: Use for interior floor walking surfaces and cement based which are not covered by any other applied floor covering.

(1) Screed, wood float and steel trowel surfaces. Finished surfaces shall be smooth, hard, dense, and free of defects. Mechanical troweling machines may be used if the desired finish and level tolerances can be obtained. Final finishing shall be by

hand troweling.

(2) Apply specified sealer/hardener in accord with manufacturer's instructions.

c. Depressed slabs for setting beds: Finish by tamping slab with an open grid tamper; screed with a straightedge and wood float to a true and uniform surface.

d. Oneway Driveway: Rake finish (3/8 min. amplitude).

e. Walks: Broom finish.

f. Sidewalks, curbs and gutters (off-site): Place and finish in accord with Department of Public Works Standards.

g. Addition of materials: The addition of cement, sand, water, or mortar to slab surfaces while finishing concrete is strictly prohibited.

h. Slab levels: Take special care to finish troweling around the edges of the slabs so finish surface at edges shall be at the same elevations as the rest of the top surface of the slab. Slabs shall be laid to temporary screeds set level at the proper elevations.

i. Mark-off lines: Form mark-off lines with curved edging tool, neat and true to line, uniform throughout. Provide markings as shown on Drawings.

3.10 DEFECTIVE WORK

a. The following concrete work will be considered defective and may be ordered by the Engineer to be removed and replaced at Contractor's expense:

(1) Concrete:

(a) Incorrectly formed.

(b) Not plumb or level.

(c) Not specified strength.

(d) Containing rock pockets, voids, honeycomb, or cold joints.

(e) Containing wood or foreign matter.

(f) Otherwise not in accordance with the intent of the Drawings and

Specifications.

(2) Concrete finishing work:

(a) Not true to elevation.

(b) Not pitched to drain where required.

(c) Not surfaced as specified.

(d) With any loose or roughened or defaced surfaces.

(e) Not true to required tolerances.

(f) Otherwise not in accordance with the intent of the Drawings and Specifications.

3.11 CLEAN-UP

a. Upon completion of work, remove and clean all splatters, efflorescence, excess material etc., resulting from concrete work, from all exposed surfaces.

b. Protect all prefinished items in the proximity of concrete work damage, splatters, etc.. Remove all excess concrete from the site, and dispose of same in a legal manner.

END OF SECTION 03300

SECTION 03412

PRECAST PRESTRESSED CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

The work includes the provision of precast, prestressed concrete herein referred to as prestressed members. Prestressed members shall be the product of a manufacturer specializing in the production of precast prestressed concrete members. In the ACI publications, the advisory provisions shall be considered to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears; reference to the "Building Official," the "Structural Engineer" and the "Architect/Engineer" shall be interpreted to mean the Contracting Officer.

1.2 SUBMITTALS:

Submit the following in accordance with the “General Conditions”.

A. DRAWINGS: Drawings for precast prestressed concrete members

Content of Drawings: Submit drawings indicating complete information for the fabrication, handling, and erection of the prestressed member. Drawings shall not be reproductions of contract drawings. Design calculations and drawings of prestressed members (including connections) shall be prepared and sealed by a registered professional engineer, and submitted for approval prior to fabrication. The drawings shall indicate, as a minimum, the following information:

1. Marking of members for erection;

2. Connections for work of other trades;

3. Connections between members, and connections between members and other construction;

4. Location and size of openings which cut prestressing strands, or require the relocation of prestressing strands to be cast in the member;

5. Joints between members, and joints between members and other

construction;

6. Reinforcing, including prestressing steel details;

7. Schedule and sequence of tensioning and detensioning prestressing strands;

8. Material properties of steel and concrete used;

9. Lifting and erection inserts;

10. Dimensions and surface finishes of each member;

11. Estimated camber;

12. Erection sequence and handling requirements;

13. All loads used in design (such as live, dead, handling, and erection);

14. Bracing/shoring required; and

15. Areas to receive toppings, topping thickness.

C. DESIGN DATA:

1. Precast prestressed concrete design calculations

2. Concrete mix design

Design Calculations: Submit calculations reflecting design in accordance with the paragraph entitled "Precast Prestressed Concrete Member Design." Design calculations and drawings of prestressed members (including connections) shall be prepared and sealed by a registered professional engineer, and submitted for approval prior to fabrication. Submit calculations for volume change as part of the design calculations.

Mix Design: Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Include a complete list of materials including type; brand; source and amount of cement, pozzolan, and admixtures; and applicable reference specifications.

D. STATEMENTS:

1. Quality control procedures

Procedures: Submit quality control procedures established in accordance with PCI MNL-116 by the prestressing manufacturer.

1.3 QUALITY ASSURANCE

Precast Prestressed Concrete Member Design: ACI 318 and the PCI MNL-120. Design prestressed members (including connections) for the design load conditions and spans indicated, and for additional loads imposed by openings and supports of the work of other trades. Design prestressed members for handling without cracking in accordance with the PCI MNL-120. Prestressed members shall have a fire rating of 4 hours in accordance with UL FRD Fire Resistance Directory, or as designed in accordance with PCI MNL-124. Concrete toppings shall be used in establishing the design strength of the prestressed members.

1.4 DELIVERY, STORAGE, AND HANDLING

Lift and support prestressed members at the lifting and supporting points indicated on the detail drawings. Store prestressed members off the ground. Separate stacked prestressed members by battens across the full width of each bearing point. Protect from weather, marring, damage, and overload.

PART 2 - PRODUCTS

2.1 CONCRETE

ACI 318M (ACI 318), for contractor furnished mix design. The minimum compressive strength of concrete at 28 days shall be 6000 psi, unless otherwise indicated.

2.2 MATERIALS

A. Concrete: Provide as specified in Section 03300 Cast-in-place Concrete.

B. Reinforcement:

1. Reinforcing Bars and Welded Wire Fabric: Provide as specified in Section 03200, Concrete Reinforcement.

C. Prestressing Strands:

1. Seven Wire Stressed Relieved: ASTM A 416 or ASTM A 416 with supplement for low relaxation wire.

D. Bearing Pads:

1. Elastomeric: AASHTO HB14, for plain neoprene bearings.

E. Cementitious Grout: Shall be a mixture of portland cement, sand, and water. Proportion one part cement to approximately 2.5 parts sand, with the amount of water based on placement method. Provide air entrainment for grout exposed to the weather.

2.3 FABRICATION

PCI MNL-116, unless specified otherwise.

A. Forms: Brace forms to prevent deformation. Forms shall produce a smooth, dense surface. Chamfer exposed edges of columns and beams 20 mm (3/4 inch), unless otherwise indicated. Provide threaded or snap-off type form ties.

B. Reinforcement Placement: ACI 318 for placement and splicing. Reinforcement may be preassembled before placement in forms. Provide exposed connecting bars, or other approved connection methods, between prestressed and cast-in-place construction. Remove any excess mortar that adheres to the exposed connections. Provide curvature or drape of the prestressing strands using approved hold-down devices.

C. Inserts: When the ends of the prestressed member will be exposed, recess the prestressing stands using inserts. After detensioning, remove inserts and fill the recess with nonshrink grout.

D. Concrete:

1. Concrete Mixing: ASTM C 94. Mixing operations shall produce batch-to-batch uniformity of strength, consistency, and appearance.

2. Concrete Placing:

ACI 304R, ACI 305R for hot weather concreting and ACI 309R, unless otherwise specified.

3. Concrete Curing: Commence curing immediately following the initial set and completion of surface finishing. Provide curing procedures to keep the temperature of the concrete between 10 and 85 degrees C (50 and 190 degrees F). When accelerated curing is used, apply heat at controlled rate and uniformly along the

casting beds. Monitor temperatures at various points in a product line in different casts.

E. Prestressing: Do not transfer prestressing forces during detensioning until the concrete has reached a minimum compressive strength of 3500 psi, unless a higher strength is required by the Contractor furnished design.

F. Surface Finish: Repairs to honeycombed sections located in a bearing area

shall be approved by the Contracting Officer prior to repairs. Prestressed members which contain honeycombed sections deep enough to expose prestressing strands shall be rejected. Prestressed members containing hairline cracks which are visible and are less than 0.5 mm (0.02 inches) in width, may be accepted. The cracked member shall be repaired. Any prestressed member that is structurally impaired shall be rejected.

G. Formed Surfaces: PCI MNL-116 (Appendix A - Commentary), Chapter 3, for grades of surface finishes.

1. Unexposed Surfaces: Provide a standard grade surface finish.

2. Exposed Surfaces: Provide a standard grade surface finish.

PART 3 - EXECUTION

3.1 SURFACE REPAIR

Prior to erection, and again after installation, check prestressed members for damage, such as cracking, spalling, and honeycombing. As directed by the Engineer, prestressed members that do not meet the surface finish requirements specified in Part 2 in paragraph titled, "Surface Finish" shall be repaired, or removed and replaced with new prestressed members.

3.2 ERECTION

Erect prestressed members after the concrete has attained the specified compressive strength, unless otherwise approved by the prestressing manufacturer. Erect in accordance with the approved detail drawings. PCI MNL-116 and PCI MNL-120 (Chapter 8), for tolerances. Provide a 1:500 tolerance, if no tolerance is specified. Brace prestressed members, unless design calculations submitted with the detail drawings indicate bracing is not required. Follow the manufacturer's recommendations for maximum construction loads. Place prestressed members level, plumb, and square within tolerances. Align member ends.

3.3 BEARING SURFACES

Shall be flat, free of irregularities, and properly sized. Size bearing surfaces to provide for the indicated clearances between the prestressed member and adjacent prestressed members or adjoining field placed surfaces. Correct bearing surface irregularities with nonshrink grout. Provide bearing pads where indicated or required. Place prestressed members at right angles to the bearing surface, unless indicated otherwise, and draw-up tight without forcing or distortion, with sides plumb.

3.4 WELDING

AWS D1.4 for welding connections and reinforcing splices. Do not weld prestressing strands. Protect the concrete and prestressing strands from heat during welding.

3.5 OPENINGS

Holes or cuts requiring prestressing steel to be cut, which are not indicated on the approved detail drawing, shall only be made with the approval of the Engineer and the prestressing manufacturer. Drill holes less than 300 mm (12 inches) in diameter with a diamond tipped core drill.

3.6 GROUTING

Clean and fill indicated keyways between prestressed members, and other indicated areas, solidly with nonshrink grout or cementitious grout. Provide reinforcing where indicated. Remove excess grout before hardening.

3.7 SEALANTS

Provide as indicated and as specified in Section 07920, "Sealants."

3.8 CONCRETE TOPPING

Provide as indicated and as specified in Section 03300, "Cast-in-Place Concrete."

END OF SECTION 03412

SECTION 03301

GROUTING

PART 1 GENERAL

1.1 GENERAL

These specifications cover materials, methods, and procedures for grouting.

All grouting shall be performed with nonshrinking grout.

1.2 MATERIALS

Materials shall be in accordance with these requirements.

Nonshrinking grout	Minimum 5,000 psi, 28 day compressive strength
Master Builders	"Masterflow 713 Grout"
Sauereisen Cements	"F-100 Grout"
Five Star Products, Inc.	"Five Star Grout"
Cormix Inc.	"Supreme Grout"
USM	"Upcon Hiflow"
L&M	"Crystex"

1.3 BASEPLATE GROUTING

a. Baseplates shall be grouted in place to obtain a uniform and solid bearing surface. Grouting methods used shall provide complete, void free, filling of all space beneath the baseplate. Equipment alignment or level of baseplates shall not be disturbed during grouting procedures.

b. Review of manufacturer's grouting recommendations is necessary to determine the appropriate grouting method to be used. Where the manufacturer's grouting recommendations differ from these requirements, this specification governs.

c. For equipment installed under the direction of a manufacturer's erection representative, grouting methods and procedures used shall be those of the representative.

(1) Surface Preparation:

(a) Surfaces of hardened concrete on which grout is to be placed shall be

prepared by chipping to remove laitance and surface mortar and to expose aggregate. Prepared surfaces shall be cleaned to remove all oil, grease, curing compound, or other foreign materials which prevent obtaining a proper bond between grout and concrete.

(b) Prepared surfaces shall be saturated with water before placing grout for not less than 24 hours.

(c) Immediately before grout placement, the prepared surfaces shall be saturated again with water and all excess water removed.

(2) Alignment and Leveling:

(a) Baseplates shall be set in place over the anchor bolts, properly aligned and leveled using three-point control. Leveling shall be by means of an extra nut below the base on each anchor bolt.

(3) Mixing:

(a) Nonshrinking grout shall be furnished factory premixed so only water is added at the jobsite. Grout shall be mixed for a minimum of 3 minutes in a mechanical mixer with the exact quantity of water recommended by the manufacturer.

(4) Placement:

(a) Proper alignment and level shall be verified and accepted before placing grout. Grout shall be used immediately after mixing before stiffening occurs. The temperature of the grout at placement shall not exceed 90 F. Placement methods used shall provide grout surfaces which are completely filled, without voids.

(b) All nonshrinking grout shall be place using the "flow" method. Control of grout water content during placement is critical. Grout shall contain only enough water to produce a flowable mixture. No excess water shall show on top when the grout is being puddled in place.

(c) Low dams enclosing the base shall be used to contain the flowable grout mixture. Adequate space shall be provided between the dam and base to permit pouring and manipulation of the grout. The top of the dam shall be higher than the bottom of the base. Flowable grout shall be placed using holes provided. If grout holes are not available or accessible, grout shall be

poured simultaneously from adjacent sides. Sufficient head shall be created to cause the grout to move in a mass. Flow may be assisted by using chains, pulsing, or puddling. The space below the base shall be filled until 1 inch of grout or more is measured above the bottom of the base on all sides of the base. All air and water pockets shall be eliminated to create a solid grout mass without voids.

(5) Finishing:

(a) Grout shall remain undisturbed after placing until a stiff set is obtained. The dam shall be removed, and the edges shall be finished by removing all excess grout and striking flush with the base, except where a sloping surface is indicated on the drawings. Sloping surfaces shall be finished to a one-to-one slope. Exposed edges of the foundation and adjacent surfaces shall be cleaned to remove all grout.

1.4 CURING

a. When finishing is completed, curing compound or wet curing for at least 7 days with a covering of wet rags and polyethylene sheets shall be used to prevent rapid loss of water from newly placed grout.

b. Extreme temperature changes are detrimental to the curing process. Special procedures to keep the grout cool shall be used when air temperatures of 90 F or higher are encountered.

END OF SECTION 03301

SECTION 04230

REINFORCED UNIT MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

a. Concrete masonry units.

b. Reinforcement, anchorage, and accessories.

1.2 REFERENCES

a. ASTM A615 - Deformed and Plain Billet Steel Bars for Concrete Reinforcement.

b. ASTM C90 - Hollow Load Bearing Concrete Masonry Units.

1.3 SUBMITTALS

a. Submit manufacturer's certificate. CMU shall meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

a. Deliver products to site.

b. Store and protect products.

1.5 SEQUENCING AND SCHEDULING

a. Coordinate work.

PART 2 PRODUCTS

2.1 CONCRETE MASONRY UNITS

a. Hollow Load Bearing Block Units: ASTM C90, Grade N, Type II - Non-moisture Controlled; normal weight.

2.2 REINFORCEMENT AND ANCHORAGE

a. Reinforcing Steel: ASTM A615, 60 ksi yield grade, deformed billet bars.

PART 3 EXECUTION

3.1 EXAMINATION

a. Verify that field conditions are acceptable and are ready to receive work.

b. Verify items provided by other Sections of work are properly sized and located.

c. Verify that built-in items are in proper location, and ready for roughing into masonry work.

d. Beginning of installation means installer accepts existing conditions.

3.2 PREPARATION

a. Direct and coordinate placement of metal anchors supplied to other Sections.

b. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.3 COURSING

a. Establish lines, levels, and coursing indicated. Protect from displacement.

b. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

c. Lay concrete masonry units in running bond. Course one unit and one mortar joint to equal 8 inches. Form concave mortar joints.

3.4 PLACING AND BONDING

a. Lay hollow masonry units with face shell bedding on head and bed joints.

b. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.

c. Remove excess mortar as Work progresses.

d. Interlock intersections and external corners.

e. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

f. Perform jobsite cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

3.5 REINFORCEMENT AND ANCHORAGES - REINFORCED UNIT MASONRY

a. Install horizontal joint reinforcement 16 inches oc.

b. Place masonry joint reinforcement in first horizontal joints above and below openings. Extend minimum 24 inches each side of opening.

c. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.

3.6 ENGINEERED MASONRY

a. Lay masonry units with core cells vertically aligned clear of mortar and unobstructed.

b. Reinforce masonry unit cores and cavities with reinforcement bars and grout.

c. Retain vertical reinforcement in position at top and bottom of cells.

d. When grouting is stopped for more than one hour, terminate grout 2 inches below top of upper masonry unit to form a positive key for subsequent grout placement.

e. Limit grout lift to 48 inches and rod for grout consolidation. Wait 30 to 60 minutes before placing next lift.

3.7 BUILT-IN WORK

a. As work progresses, build in other items furnished by other Sections.

b. Build in items plumb and level.

c. Do not build in organic materials subject to deterioration.

3.8 TOLERANCES

a. Maximum Variation From Plane of Wall: 1/4 inch in 10 feet and 1/2 inch in 20 feet or more.

b. Maximum Variation From Plumb: 1/4 inch per story non- cumulative; 1/2 inch in two stories or more.

c. Maximum Variation From Level Coursing: 1/8 inch in 3 feet and 1/4 inch in 10 feet.

3.9 CLEANING

a. Clean work for final inspection.

b. Remove excess mortar and mortar smears.

c. Replace defective mortar. Match adjacent work.

d. Clean soiled surfaces with cleaning solution.

e. Use non-metallic tools in cleaning operations.

3.10 PROTECTION OF FINISHED WORK

a. Without damaging completed work, provide protective boards at exposed external corners which may be damaged by construction activities.

END OF SECTION 04230

SECTION 04812

GLASS MASONRY ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes glass masonry units; mortar bed and pointing sealant; and perimeter treatment.

B. Related Sections:
   1. Section 07920 - Sealant: Perimeter caulking and sealant tooled joints.

1.2 REFERENCES

A. ASTM International:
   1. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

B. The Masonry Society:
   1. TMS MSJC - Building Code for Masonry Structures (ACI 530/ASCE 5/TMS 402), Specification for Masonry Structures (ACI 530.1/ASCE 6/TMS 602) and Commentaries.

1.3 SUBMITTALS

A. Product Data: Submit data for glass units, accessories.

B. Samples: Submit two glass units color, design, face pattern.

C. Manufacturer's Installation Instructions: Submit special procedures, positioning of reinforcement, perimeter conditions requiring special attention.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

B. Installer: Company specializing in performing Work of this section with minimum three years experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept glass units on site on pallets. Inspect for damage.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Hot and Cold Weather Requirements: TMS MSJC Specification.

1.7 EXTRA MATERIALS

A. Supply ten of each type and size of glass unit.

PART 2 PRODUCTS

2.1 GLASS MASONRY ASSEMBLIES

A. Furnish materials in accordance with Public Work's standards.

2.2 COMPONENTS

A. Hollow Glass Units: Unit core filled with white thermal insulation. Permanently seal hollow unit by heat fusing joint with joint key to assist mortar bond.
   1. Nominal Size: 7-3/4x7-3/4_x 3-1/2 inch
   2. Color: Clear glass.
   3. Pattern and Design: VUE pattern.
   4. Insulation Value: U-value of 0.34 BTU/sq ft/h/degree F
   5. Compressive Strength: 400-600 psi
   6. Visible Light Transmittance: 70 percent.

B. Mortar and Grout

C. Pointing Sealant: Acrylic type, color selected.

2.3 ACCESSORIES

A. Panel Reinforcement: Steel, hot dip galvanized to ASTM A153/A153M finish.
   1. Side Rods: Two 9 gage rods spaced 2 inches apart.
   2. Cross Rods: 14 gage rods welded 8 inches oc.

B. Expansion Strips: Dense glass fiber matting, 7/16 x 4 inches nominal size.

C. Panel Anchors: Steel strips, 20 gage thick x 1 3/4 inch wide; punched with three rows of elongated holes, pattern staggered, hot dip galvanized to ASTM A153/A153M finish.

D. Perimeter Channel: Extruded aluminum channel profile, 4-3/4 x 1-1/4 x 1/8 inch size, one piece per length installed, mill finish.

E. Asphalt Emulsion: Water based.

2.4 MIXES

A. ASTM C 270, Type S, white portland cement.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive work.

3.2 PREPARATION

A. Clean glass units of substances that impair bond with mortar or sealant.

B. Establish and protect lines, levels, and coursing.

C. Protect elements surrounding work of this section from damage or disfiguration.

3.3 INSTALLATION

A. Locate and secure perimeter metal chase.

B. Coat sill under units with asphalt emulsion as bond breaker, and allow to dry.

C. Set panel anchors in mortar bed directly over coating.

D. Install masonry with full mortar joints. Furrowing not permitted. Remove excess mortar.

E. Maintain uniform joint width of 1/4 inch.

F. Place panel reinforcement at every second horizontal joint in full mortar bed and at first course above and below openings within glass unit panel.

G. Lap reinforcement joints 6 inches. Discontinue reinforcement at expansion joints.

H. Remove excess mortar.

3.4 ERECTION TOLERANCES

A. Variation From Joint Width: Plus or minus 1/8 inch and minus 0 inches.

B. Maximum Variation from Plane of Unit to Adjacent Unit: 1/32inch.

C. Maximum Variation of Panel from Plane: 1/8 inch.

3.5 CLEANING

A. Do not scratch or deface units.

END OF SECTION 04812

SECTION 05500

METAL FABRICATIONS

PART 1 GENERAL

1.1 WORK INCLUDED

a. Shop fabricated ferrous metal items galvanized.

b. Refer to Schedule at end of this Section.

1.2 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

a. Furnish metal fabrications to be cast in concrete to meet Cast-In-Place Concrete Section.

1.3 REFERENCES

a. ASTM A36 - Structural Steel.

b. ASTM A325 - High Strength Bolts for Structural Steel Joints.

c. ASTM A386 - Zinc-Coating (Hot-Dip) on Assembled Steel Products.

d. ASTM A500 - Cold-formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

e. AWS D1.1 - Structural Welding Code.

f. FS TT-P-641 - Primer Coating, Zinc Dust-Zinc Oxide (for Galvanized Surfaces.)

1.4 SHOP DRAWINGS

a. Submit shop drawings.

b. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.

c. Include erection drawings, elevations, and details where applicable

d. Indicate welded connections using standard AWS welding symbols. Indicate net weld lengths.

1.5 CERTIFICATE

a. Submit Welder's Certificate.

PART 2 PRODUCTS

2.1 MATERIALS

a. Steel Sections: ASTM A36.

b. Steel Tubing: ASTM A500, Grade B.

c. Bolts, Nuts, and Washers: ASTM A325.

d. Welding Materials: AWS D1.1; type required for materials being welded.

e. Primer: FS TT-P-31, red for shop application and fields touch-up.

f. Touch-up Primer for Galvanized Surfaces: FS TT-P-641.

2.2 FABRICATION

a. Verify dimensions on site prior to shop fabrication.

b. Fabricate items with joints tightly fitted and secured.

c. Fit and shop assemble in largest practical section, for delivery to site.

d. Grind exposed welds flush and smooth with adjacent finished surface. Ease exposed edges to small uniform radius.

e. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of structure, except where specifically noted otherwise.

f. Make exposed joints butt tight, flush, and hairline.

g. Supply components required for anchorage of metal fabrications. Fabricate anchorage and related components of same material and finish as metal fabrication, except where

specifically noted otherwise.

2.3 FINISH

a. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

b. Do not prime surfaces in direct contact bond with concrete or where field welding is required.

c. Prime paint items scheduled with two coats.

d. Galvanize items to minimum 2.0 oz/sq ft zinc coating in accordance with ASTM A386.

PART 3 EXECUTION

3.1 PREPARATION

a. Obtain Engineer approval prior to site cutting or making adjustments not Scheduled.

b. Clean and strip site primed steel items to bare metal where site welding is scheduled.

c. Make provision for erection loads with temporary bracing. Keep work in alignment.

d. Supply items required to be cast into concrete with setting templates, to appropriate Sections.

3.2 INSTALLATION

a. Install items plumb and level, accurately fitted, free from distortion or defects.

b. Perform field welding in accordance with ASWS D1.1.

c. After installation, touch-up field welds, scratched or damaged surfaces with primer.

3.3 SCHEDULE

a. Provide and install items shown on Drawings with anchorage and attachments necessary for installation.

b. Fabricated frames and grating plate covers for manholes catch basins sump trenches pits; galvanized finish.

c. Floor grating and catwalks including structural supports; galvanized finish.

d. Fabricated floor mat recess frames; galvanized, descaled mill finish.

END OF SECTION 05500

SECTION 05501

MISCELLANEOUS METALS

PART 1 GENERAL

1.1 GENERAL

This section covers the materials, fabrication, and erection requirements for miscellaneous metals.

Except as otherwise specifically noted on the drawings, or specified herein, all materials furnished and work performed in connection with miscellaneous metals work shall be in conformity with the latest edition of the AISC "Manual of Steel Construction".

1.2 DRAWINGS

Detailed fabrication and erection drawings for all materials shall be prepared, checked, and submitted in accordance with the requirements.

PART 2 PRODUCTS

2.1 MATERIALS

a. Materials shall be new and undamaged and shall conform to pertinent AISC and ASTM standard specifications and the following requirements.

(1)	Structural shapes and plates not otherwise noted	ASTM A36 steel, galvanized. Minimum yield point of 36,000 psi including appurtenant materials
(2)	Shapes and plates noted "galv" or "galvanized" on the drawings	ASTM A36 steel, galvanized
(3)	Shim pack	ASTM A36 steel
(4)	Structural tubing	ASTM A500 Grade B steel, structural tube shapes
(5)	Steel pipe	ASTM A53 Type E or S, Grade B steel pipe with yield strength of 35,000 psi.

		Galvanized
(6)	Shop and field bolts	ASTM A325 Type 1 bolts, nuts, and washers. Galvanized where any connection component is aluminum or galvanized steel. Galvanized nuts shall be lubricated as specified in ASTM A325.
(7)	Flat and beveled	ASTM A325, quenched and washer tempered, compatible with Type 1 bolts. Galvanized if any connection components is galvanized
(8)	Threaded inserts for	Dayton Sure-Grip "Type F-5," concrete Gateway "Type J," or acceptable equal. Galvanized
(9)	Continuous inserts	"Unistrut," "Kindorf," "Binkley," or acceptable equal. Galvanized
(10)	Pulling eyes	McGraw-Edison No. DU2T3 or acceptable equal
(11)	Anchor bolts 3/4 inch	ASTM A36 threaded bars or ASTM and larger A307 Grade B, with nuts conforming to ASTM A563 Grade A heavy hexagon; all galvanized after fabrication
(12)	Anchor bolts smaller	ASTM A307 Grade A or B with hexagon than ¾" heads and ASTM A563 Grade A hexagon nuts; all galvanized after fabrication
(13)	Expansion anchors	Fed Spec FF- S- 325, Group II, Type 3, Class 3; Group II, Type 4, Class 1; or Group VIII, Type 1 or Type 2, Hilti Kwik-Bolt, ITT Phillips Red Head Wedge and Sleeve Anchors, Ramset Trubolt and Dynabolt, Drillco Maxi-Bolt, or acceptable equal
(14)	Concrete anchors	Welded stud type, 3/8 inch by 4 inches, Nelson Stud Welding, Erico Products "Blue Arc," KSM Welding Systems, or

		acceptable equal, unless otherwise indicated on drawings
(15)	Welding electrodes	American made including flux
(16)	ASTM A36 steel	Low hydrogen types, AWS D1.1-90 (as specified in Table 4.1 "Matching filler metal requirements"). Tensile strength range of 70,000 psi minimum
(17)	Shop applied coatings	
	(a) Galvanizing	ASTM A123, ASTM A153, and ASTM A385

b. Bolt Inspection – Manufacturer:

(1) Bolts shall be inspection tested, by the manufacturer, prior to shipment in accordance with the Shipping Lot Method described in ASTM A325, Article 9.3. A copy of the inspection test reports shall be forwarded by the Contractor to the Owner.

(2) Random samples of the bolts may be field tested to verify that bolt tensile requirements and chemical composition are met. A lot shall be rejected if any field test or metallurgic investigation fails to meet the applicable test requirement.

PART 3 EXECUTION

3.1 FABRICATION

a. Miscellaneous metals shall be fabricated in conformity with the dimensions, arrangements, sizes, and weights or thicknesses indicated on the drawings or stipulated in the specifications. Framing and connections of all members shall be detailed and fabricated in accordance with AISC standards, specifications, and details unless otherwise indicated on the drawings or specified herein.

b. All fabricated materials shall conform to the tolerances specified in the AISC Manual and ASTM A6. For exposed trusses and similar structures, the allowable tolerance for sweep shall be no more than 1/8 inch in 10 feet of length regardless of the type of steel section. If necessary, the Contractor shall cull out or straighten materials which do not comply with the specified tolerances. Materials which do not comply with the specified sweep and camber requirements may be rejected.

c. All members and other parts of fabricated material, as delivered, shall be free of winds, warps, local deformations, unauthorized splices, or unauthorized bends. Holes and other provisions for field connections shall be accurate and shop checked so proper fit will be provided when the units are assembled in the field. Erection drawings shall be prepared and all separate pieces shall be piece marked as indicated on the drawings. Where required, either by notations on the drawings or by the necessity of proper identification and fitting of field connections, the connections shall be matchmarked.

(1) Shapes and Plates:

(a) Shapes and plates shall be fabricated and assembled in the shop to the greatest extent practicable. Shearing, flame cutting, and chipping shall be done carefully, neatly, and accurately. Holes shall be cut, drilled, or punched at right angles to the surface and shall not be made or enlarged by burning. Holes shall be clean-cut without torn or ragged edges, and burrs resulting from drilling or reaming operations shall be removed with the proper tool.

(b) Shapes and plates shall be fabricated to tolerances that will permit field erection within AISC tolerances except as otherwise specified.

(c) Contact surfaces at all connections shall be free of loose scale, dirt, bu burrs, oil, and other foreign materials that would prevent solid seating of the parts.

(d) Baseplates shall be neatly cut to the proper size. The top surface shall be pressed or milled to provide full bearing to the column.

(e) The radius of coped or blocked sections shall be provided free of notches, cuts, or cracks.

(f) All re-entrant corners shall be shaped notch free to a radius of at least 1/2 inch.

(g) Plates bent at an angle greater than 90 degrees shall be forged to prevent cracking and reduction in metal thickness.

(h) Bolting:

(a) Typical shop beam connections shall be all welded. If shop bolted connections are used, gauges of connections shall be modified to

provide adequate clearance for bolting tools when the steel is erected. Typical field beam connections shall be bolted with high strength bolts. When a particular connection method (bolting or welding) is specified or detailed for a particular connection or class of connections, such particular method shall take precedence over the typical connections.

(b) All bolts shall be 3/4 inch diameter unless otherwise indicated on the drawings.

(c) High strength bolts and their installation and bolting tools and equipment shall conform to all requirements for A325 bolts of the "Specification for Structural Joints Using ASTM A325 or A490 Bolts" including the commentary given therewith, as approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation, and endorsed by AISC, except as otherwise modified and supplemented herein. The Research Council specification is dated August 14, 1980. Bolt length shall be determined in accordance with the Research Council specification and commentary.

(d) High strength bolted connections shall be bearing type connections with threads permitted in the shear plane except where other type connections are required by the drawings or specifications. Contact surfaces of bearing type connections may be painted.

(e) Tightening of bolts shall be controlled using the "turn-of-nut" method.

(i) Anchor Bolts:

(a) Anchor bolts furnished under these specifications shall be as listed and detailed on the drawings. Sleeves and anchor plates shall be provided where they are indicated on the drawings. Unless otherwise indicated on the drawings, fabrication details for all anchor bolts shall comply with ASTM A307. Anchor bolts, nuts, and washers shall be hot-dip galvanized after fabrication, threads being undercut to provide a tolerance equal to ANSI Class 2A. Each bolt without a sleeve shall be furnished with two nuts and sufficient threads to permit a nut to be installed on each side of the concrete form or template.

(j) Embedments:

(a) Embedded materials shall be accurately fabricated and assembled. Warped or bent sections, which do not fit into the concrete forms as required, shall be replaced with suitable material. All materials embedded in concrete shall be galvanized after fabrication except steel framing members, reinforcing steel, baseplates, concrete anchors, and pipe hanger supports.

(b) Sleeves through concrete, except as otherwise noted, shall be fabricated from standard weight steel pipe or from 3/16 inch thick steel plate. Sleeves shall be machine cut or flame cut and ground smooth. Sleeves having a diameter greater than 12 inches shall be made from 3/8 inch thick steel plate. Each sleeve shall be provided with anchors welded to the sleeve as indicated on the drawings. The maximum spacing of anchors shall be 18 inches except that a minimum of three anchors shall be provided for each sleeve. Floor sleeves shall project 4 inches above the floor line.

3.2 WELDING

a. Steel Welding. Except as otherwise specified, all welds, welding, and related operations for steel shall be in conformity with the applicable provisions of the AWS Structural Welding Code, AWS D1.1-90 as issued by the American Welding Society.

b. The footnotes of Table 2.2 of the referenced AWS code shall not apply to statically loaded structures.

c. Except as otherwise specified, welding shall be performed using only those joint details and welding procedures which are prequalified in accordance with the referenced AWS code.

d. All welding procedures shall be submitted to the Owner for review prior to beginning the work.

e. Welding processes, materials, and joint designs that are not in accordance with the referenced AWS code shall be qualified by tests prescribed by the code, and the Contractor shall include the procedure qualification test records with the welding procedures submitted to the Owner.

g. All welders, welding operators, and tackers shall be tested and examined by an independent testing laboratory in accordance with the applicable provisions of the referenced AWS code. Accurate records of welder, welding operator, and tacker qualifications shall be certified and maintained by the Contractor and shall be made

available to the Owner upon request.

h. Only E71T-1 and E71T-5 electrodes with supplemental shielding gas will be permitted when using the flux cored arc welding process.

i. The use of short-circuiting, when using the gas metal arc welding process, will not be permitted.

j. Low hydrogen electrodes shall be stored and handled during use in a manner that will maintain their low hydrogen characteristics. The methods used for storage and handling shall be fully explained in the welding procedures submitted or in separate electrode storage and handling procedure submitted to the Owner for review prior to beginning the work.

k. All welded joints exposed in exterior locations or subject to submergence in any location shall be provided with continuous welds along all contact edges except as prohibited in Article 8.8.5 of the referenced code.

l. Welds that are not dimensioned on the Owner's drawings shall be sized to develop the full strength of the least strength component involved in the connection.

m. All welds shall be properly identified on the detailed shop drawings and shall be subject to acceptance by the Owner.

n. Components to be welded shall be accurately positioned and shall be rigidly secured during welding.

3.3 GENERAL INSPECTION

a. Inspection criteria for all inspection methods shall comply with AWS D1.1-90, Section 8 Statically Loaded Structures.

b. The Contractor shall be responsible for inspection of the work to assure conformance to the requirements of these documents. Personnel responsible for visual inspection and acceptance of welding shall be Certified Welding Inspectors qualified and certified in accordance with American Welding Society AWS QC1, Standard for Qualification and Certification of Welding Inspectors. Article 6.1.3.2 of the referenced edition of AWS D1.1 shall not be applicable to the work under this Contract.

c. Personnel performing welding inspection shall be responsible for verifying that all aspects of the welding operation are in accordance with the requirements defined in Section 6 of the referenced edition of AWS D1.1.

3.4 GALVANIZING

a. Metal materials which are specified herein or indicated on the drawings to be galvanized shall be hot-dip galvanized in accordance with ASTM A123, ASTM A153, and ASTM A385. Materials specified to be galvanized shall be prepared for galvanizing by being properly cleaned, pickled, rinsed, and dried. The cleaned materials shall be immediately galvanized before any rusting can occur.

3.5 ERECTION

a. Metal materials shall be erected in accordance with AISC, the Owner's drawings, the erection drawings, and these specifications. Unless specified otherwise, erection tolerances shall be the same as those specified herein under the article titled FABRICATION.

b. All parts shall be assembled accurately and matchmarks shall be carefully followed. Light drifting to draw the parts together will be acceptable, but drifting to match unfair holes will not be acceptable. Any enlargements of holes necessary to make connections in the field shall be done by reaming with twist drills, care being taken not to weaken the adjoining metal. Enlarging of holes by burning is prohibited. Connections requiring extensive hole enlargements or adjustments, other than provided for by shop fabricated slotted holes, shall be brought immediately to the Owner's attention. The necessary adjustments shall be made under the direction of the Owner.

c. All joints shall be assembled, abutting surfaces shall be drawn tightly together, and the framework shall be checked for alignment, plumb, and level in accordance with the specified tolerances.

d. Smooth beveled washers shall be used when the bearing faces of the bolted parts have a slope of 1:20 or greater with respect to a plane normal to the bolt axis. Anchor bolts and other materials embedded in concrete shall be installed as specified in the section titled CAST-IN-PLACE CONCRETE.

3.6 TOUCHUP GALVANIZING

a. Galvanized surfaces scratched or otherwise damaged during delivery, unloading, or erection shall be thoroughly cleaned by wire brushing the damaged area to remove all loose, cracked, or bruised galvanizing.

b. Cleaned areas shall be regalvanized with "Galvanizing Powder M-321" as manufactured by the American Solder and Flux Company of Philadelphia, Pennsylvania; with "Zincilate 810" as manufactured by Industrial Metal Protectives, Inc., of Dayton, Ohio; with "Zinc Rich" coating as manufactured by ZRC Chemical Products Company, Quincy,

Massachusetts; or acceptable equal. The Contractor shall furnish this protective material and shall apply it in the field to any surface where the galvanized coating is broken or removed either intentionally or unintentionally.

END OF SECTION 05501

SECTION 07213

BATT INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Section includes batt insulation in ceiling or roof construction.

1.2 REFERENCES

A. ASTM International:
   1. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
   2. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

A. Product Data: Submit data on product characteristics, performance criteria, limitations.

B. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

PART 2 PRODUCTS

2.1 BATT INSULATION

A. Furnish materials in accordance with Public Work’s standards.

2.2 COMPONENTS

A. Batt Insulation: ASTM C665; preformed batt, conforming to the following:
   1. Thermal Resistance: R of 19
   2. Facing: Faced on one side with asphalt treated Kraft paper.
   3. Flame/Smoke Properties: in accordance with ASTM E84.

B. Sheet Vapor Retarder: polyethylene film for above grade application, 6 mil thick.

C. Nails: Steel wire; type and size to suit application.

D. Tape: Bright aluminum self-adhering type, mesh reinforced, 2 inch wide.

E. Insulation Fasteners: Steel impale spindle and clip on flat metal base, self adhering backing, length to suit insulation thickness, capable of securely and rigidly fastening insulation in place.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify substrate, adjacent materials, and insulation are dry and ready to receive insulation.

3.2 INSTALLATION

A. Install in ceiling spaces without gaps or voids. Do not compress insulation.

B. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

C. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within plane of insulation.

D. Retain in place with spindle fasteners per manufacturer's recommendation.

E. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.

F. Install Work in accordance with Public Work’s standards.

END OF SECTION 07213

SECTION 07540

FLUID APPLIED ROOFING

PART 1 GENERAL

1.1 DESCRIPTION

Work required under this Section consists of furnishing all labor, materials, tools, equipment, and services necessary for the application of an elastomeric roofing system for the roof as directed on the Contract Drawings.

1.2 QUALITY ASSURANCE

a. Membrane Manufacturer: Company specializing in liquid waterproofing membrane systems with three years minimum experience.

b. Applicator Company specializing in application of specified waterproofing approved by manufacturer and with not less than three years experience.

1.3 SUBMITTALS

a. Submit manufacturer's specifications, installation instructions, and general recommendations for each elastomeric roofing materials required. Include data substantiating that material complies with requirements.

b. Submit shop drawings detailing special joint or termination conditions and conditions of interface with other materials.

c. Submit samples of roofing of required thickness on a 12" x 12" x 1" sample of type of concrete used on job, for approval.

1.4 ENVIRONMENTAL REQUIREMENTS

Proceed with work of this section only when existing and forecasted weather conditions will permit work to be performed in accordance with manufacturer's recommendations. Protect materials as recommended by manufacturer.

1.5 WARRANTY

a. Provide written maintenance warranty, signed by CONTRACTOR, Manufacturer and Installer,

agreeing to replace/repair defective materials and workmanship, defined to include leakage of water, ruptures caused by cracking substrate up to 1 /16", abnormal ageing or deterioration of materials, and other failures of membranes to perform as required within warranty period. Warranty shall include responsibility for removal and replacement of other work which conceals membrane roofing. During warranty period, repairs and replacements required because of acts of God and other events beyond CONTRACTOR's/Installer's control (and which exceed performance requirements) shall be completed by CONTRACTOR/Installer and paid for by OWNER at prevailing rates.

b. Provide five years with an extension to ten years after date of substantial completion.

1.6 DELIVERY AND STORAGE

All materials shall be delivered in its original unbroken manufacturer's packages or containers, with the original labels and brand name on the package. Failure to provide the aforementioned shall subject the materials to removal from the project site.

PART 2 PRODUCTS

2.1 MANUFACTURERS

The elastomeric urethane roofing system shall be based on the "Multi-Thane 4556-75 Mil" as manufactured by Multi-Chemical Products, Inc. or equal.

2.2 MATERIALS

a. Primer: Shall be MIP-067 epoxy-polyamide, low viscosity, two-component primer sealer.

b. Base Membrane: Shall be "Multi-l-Thane 4000" single-component, high-adhesion, moisture cured, liquid polyurethane membrane, 85% weight solids.

c. Second Coat Membrane: Shall be "Multi-l-Thane 5000" single component, high tensile strength, liquid applied elastomeric polyurethane, 85% weight solids.

d. Aggregate: Equal to or finer than 20 mesh flint shot silica, ground glass, or Monterey sand. Aggregate shall be hard and stable to atmospheric conditions, clean and free of any other material, chemicals or salt.

e. Top Coat: Shall be "Multi-l-Thane 6000" single component, high tensile strength, abrasion resistant and weather-resistant aliphatic polyurethane membrane 53% solids.

f. Caulking: "Multi-l-Seal 1000", one component polyurethane compound.

PART 3 EXECUTION

3.1 INSPECTION

a. The waterproofing applicator shall verify surfaces are solid, free of loose particles, cracks, pits, rough projections, and foreign matter detrimental to adhesion and application of waterproofing. Should any deficiencies exist, the ENGINEER shall be notified in writing and corrections made by CONTRACTOR.

b. Verify items which penetrate surfaces to receive waterproofing are securely installed.

c. Beginning of installation means acceptance of substrate.

3.2 PREPARATION

a. Clean and prepare surfaces to receive waterproofing, in accordance with manufacturer's instructions. Acceptable methods of cleaning are sandblasting, acid etching or mechanical grinding followed by the complete and thorough removal of any residue.

b. All cracks over 1 /16" in width shall be routed to 1/4" minimum in width and depth and filled flush with polyurethane elastomeric sealant.

c. All cracks shall be stripe-coated with 30 mils of "Multi-l-Thane 4000" coating for a distance of 2 inches on either side of the crack.

d. Apply a 2-inch face coat stripe of "Multi-l-Thane 4000" around all pipes, drains and vertical junctions.

e. Mask off adjoining surfaces not to receive elastomeric to effectively prevent spillage or overspray of liquid materials outside membrane area.

3.3 INSTALLATION

a. Comply with manufacturer's instructions except where more stringent requirements are shown or specified, and except where project conditions require extra precautions or provisions to ensure satisfactory performance of work. Start installation of waterproofing membrane only in presence and with advice of manufacturer's technical representative.

b. Apply uniform coating of waterproofing to substrate and adjoining surfaces indicated to

receive membrane. Apply coating only be machine spray, approved by manufacturer, except where manufacturer's recommendations indicate hand application.

c. Provide a thickness of 65-mils for the base coating and 10-mils of top coating for a total dry film thickness of 75 mils excluding aggregate.

d. Retain empty containers of waterproofing materials to aid in computing actual average thicknesses of applications.

e. Permit membrane to cure under conditions which will not contaminate or deteriorate waterproofing material. Block off traffic and protect membrane from physical damage. No traffic allowed for the first 24 hours during/after application and no heavy traffic 4 days after final coat.

3.4 FIELD QUALITY CONTROL

a. On completion of membrane installation, dam installation in preparation for floor testing.

b. Flood to minimum depth of one with clean water. After 48 hours, check for leaks.

c. If leaking is found, patch using new waterproofing materials; repeat flood-test. Repair damage to building.

d. When area is proved watertight, drain water.

END OF SECTION 07540

SECTION 07920

SEALANTS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The applications are referred to in the text by the basic designation only.

a. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C919	1984 (1988) Use of Sealants in Acoustical
ASTM C920	1987 Elastic Joint Sealants
ASTM C962	1986 Use of Elastomeric Joint Sealants

1.2 SUBMITTALS

Submit the following:

a. Manufacturers' Catalog Data

1) Sealants.
2) Primers.
3) Backstop Materials.

b. Data for sealants shall include shell life, and recommend cleaning solvents.

1.3 DELIVERY AND STORAGE

Deliver materials to the job site in the manufacturers' external shipping containers, unopened, with brand names, date of manufacture, color, and materials designation clearly marked thereon. Elastomeric sealant containers shall be labeled as to type, class, grade, and use. Carefully handle and store all materials to prevent inclusion of foreign materials or subjection to sustained temperatures exceeding 100 degrees F.

PART 2 PRODUCTS

2.1 SEALANTS

Provide sealant that has been tested and found suitable for the substrates to which it has been applied. Sealants shall not contain asbestos.

a. Interior Sealants: ASTM C920, Type S or C, Grade NS, Class 12.5, Use NT. Use ASTM C920 sealant unless otherwise specified. Locations and colors of sealant shall be as follows:

LOCATIONS	COLORS
1) Small voids between walls and adjacent door frames, and similar items.	Match adjacent surface color.
2) Perimeter of frames at doors which adjoin exposed interior concrete surfaces.	Match adjacent surface color.

b. Exterior Sealants: For joints in vertical surfaces, provide ASTM C920, Type S or M, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C920, Type S or M, Grade P, Class 25, Use T. Locations and colors of sealant shall be as follows.

LOCATIONS	COLORS
1) Joints and recesses formed where frames and subsills of doors, louvers, and vents adjoin concrete, or metal frames. Use sealant at both exterior and interior surfaces of exterior wall penetrations.	Match adjacent surface color.
2) Voids where items pass through exterior walls.	Match adjacent surface color.
3) Metal-to-metal joints where sealants is indicated or specified.	Match adjacent surface color.
4) Joints between ends of fascias, copings, and	Match adjacent surface color.

adjacent walls.

c. Floor Joint Sealant: ASTM C920, Type S or M, Class 25, Use T, and be acid resistant. Color of sealant shall be as selected.

2.2 PRIMER FOR SEALANT

Provide non-staining, quick-drying type and consistency recommended by the sealant manufacturer for the particular application.

2.3 BOND BREAKERS

Provide type and consistency recommended by the sealant manufacturer for the particular application.

2.4 BACKSTOPS

Provide glass fiber roving or neoprene, butyl, polyurethane, or polyethylene foams free from oil or other staining elements as recommended by the sealant manufacturer. Backstop material shall be compatible with the sealant. Do not use oakum and other types of absorptive materials as backstops.

2.5 CLEANING SOLVENTS

Provide types recommended by the sealant manufacturer.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Render surfaces clean, dry to the touch, and free from moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would tend to destroy or impair adhesion.

3.2 SEALANT PREPARATION

Do not add liquids, solvents, or powders to the sealants. Mix multicomponent elastomeric sealants in accordance with manufacturer's printed instructions.

3.3 APPLICATION

Comply with the requirements of ASTM C962 for the use of elastomeric sealants as applicable to the materials, applications, and conditions required. Where joints of unacceptable width-to-depth ratios have not been provided, clean out joints to acceptable depths and grind or cut to acceptable widths

without damage to the adjoining work. Grinding will not be required on metal surfaces.

a. Joint Width-To-Depth Ratio:

	JOINT WIDTH MINIMUM	JOINT DEPTH MAXIMUM
1) For metal, glass, or other nonporous surfaces:		
1/4 inch, minimum	1/4 inch	1/4 inch
Over 1/4 inch	1/2 of width	Equal to width
2) For concrete		
1/4 inch, minimum	1/4 inch	1/4 inch
Over 1/4 inch to 1/2 inch	1/4 inch	Equal to width
Over 1/2 inch to 2 inches	1/2 inch	5/8 inch
Over 2 inches	(As recommended sealant by manufacturer)	

b. Backstops: Install backstops dry and free from tears or holes. Tightly pack the back or bottom of joint cavities with backstop materials to provide a joint of the depth specified. Install backstops in the following locations:

1) Where indicated.

2) Where backup is not to indicated but joint cavities exceed the acceptable maximum depths specified in paragraphs entitled, "Joint Width-To-Depth Reactions."

c. Primer: Immediately prior to applications of the sealant, clean out all loose particles from joints. Where recommended by sealant manufacturer, apply primer to joints in concrete masonry units, wood, and other porous surfaces in accordance with compound manufacturer's instructions. Do not apply primer to exposed finish surfaces.

d. Bond Breaker: Provide bond breakers to the back or bottom of joint cavities, as recommended by the sealant used to prevent sealant from adhering to these surfaces.

Carefully apply the bond breaker to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the bond breaker.

e. Sealants: Provide sealant compatible with the material to which it is applied. Do not use a compound that has exceeded its shelf life or has become too jelled to be discharged in a continuous flow from the gun. Apply the compound in accordance with manufacturer's instructions with a gun having a nozzle that fits the joint width. Force sealants into joints to fill the joints solidly without pockets. Sealants shall be uniformly smooth and free of wrinkles. Upon completion of sealant application, roughen partially filled or unfilled joints, apply sealant, and tool smooth as specified.

3.4 PROTECTION AND CLEANING

a. Protection: Protect areas adjacent to joints from compound smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled.

b. Final Cleaning: Upon completion of compound application, remove all remaining smears and stains therefrom and leave the work in a clean and neat condition.

END OF SECTION 07920

SECTION 08110

STEEL DOORS AND FRAMES

PART 1 GENERAL

1.1 DESCRIPTION

This Section provides specifications for stainless steel doors and frames.

1.2 QUALITY ASSURANCE

Provide stainless steel entrances and framing systems produced by a single firm with not less than 5 year of successful experience in fabrication of work of types required for this project.

1.3 SUBMITTALS

a. The CONTRACTOR shall submit manufacturer's specifications, standard details, and installation recommendations and shop drawings for fabrication and installation showing elevations, detail sections of typical composite members, anchorages and reinforcement.

b. Submit samples 12 inch long sections of extrusions or formed shapes.

c. Submit design calculations certified by a professional engineer for doors, frames and anchoring devices. Doors, frames and its anchoring devices shall be designed to withstand force induced by wind with a velocity of 155 miles per hour. Use wind loading requirements of the 2006 International Building Code, exposure "C".

d. Submit to ENGINEER the manufacturer's written warranty against defects in materials and workmanship. The warranty shall cover a time period of two years after the date of final acceptance of the project.

1.4 DELIVERY, STORAGE AND PROTECTION

Protect doors and frames with resilient packaging sealed with heat shrunk plastic.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

Stainless steel doors and frames shall be as manufactured by Fenestra Corporation, Erie, Pennsylvania or approved equal.

2.2 DOOR CONSTRUCTION

a. Face sheets shall be No. 16 U.S. gauge No. 304 stainless steel with No. 4 finish.

b. Door face as well as lock and hinge edges shall have a smooth seamless and unbroken surface. Doors shall be rigid, free from warpage or buckle. Corner bends shall be true and straight and of minimum radius for the gauge of metal used.

c. Lock and hinge edges shall be formed by a full overlap of each face sheet around continuous reinforcements at the hinge and lock edges for the full height of door assuring maximum strength.

d. Face sheets shall be bonded under controlled heat and pressure to an inner core consisting of honeycomb extending full width and height of the door. The honeycomb core shall have a minimum of 1/2" cell. The compression strength shall be 7.632 lbs/sq. ft. minimum.

e. The edge seams formed by the face sheets at the lock and hinge stiles shall be closed by a continuous heli-arc process weld, making the outer surface of the door an uninterrupted encasement of steel.

f. All doors shall mortised and reinforced to allow field application of hinges and locks in accordance with the approved hardware schedule and templates supplied by the hardware contractor. Where surface mounted hardware is to be applied, doors shall have reinforcing plates only; all drilling and tapping shall be by others. The minimum gauge for reinforcing plates shall be as follows:

   1) Hinged and pivot reinforcements - 7 gauge.

   2) Reinforcements for lock face, flush bolts, concealed holders, concealed or surface-mounted closer - 12 gauge.

   3) Reinforcements for other surface-mounted hardware - 16 gauge.

g. After fabrication, all tool marks and surface imperfections shall be dressed as required to make all faces and vertical edges smooth, level and free of all irregularities.

h. All internal reinforcements shall be manufactured from stainless steel unless specified otherwise.

2.3 FRAME

a. The frame shall be formed from No. 16 gauge. 304 stainless steel with No. 4 finish.

b. Frames shall be mortised, reinforced, drilled and tapped at the factory for fully template mortised hardware only, in accord with approved hardware schedule and templates provided by the hardware contractor.

1) Minimum thickness of hardware reinforcement plates shall be as follows:

Hinge and pivot reinforcements - 7 gauge, 1-1/4" x 8-3/4" min.
Strike reinforcements - 14 gauge extruded
Flush bolt reinforcements - 12 gauge
Closer reinforcements - 14 gauge
Reinforcements for other surface-mounted hardware - 12 gauge

2.4 WIND LOADING

The doors and frames shall be designed to withstand a 170 miles per hour wind velocity. Use wind loading requirements of the 2009 International Building Code, exposure "C".

PART 3 EXECUTION

3.1 INSTALLATION

a. Shall comply with manufacturer's instructions and recommendations for installation of stainless steel doors and frames.

b. Shall be set plumb, level, and true to line, without warp or rack of framing members or doors. Anchor securely in place.

3.2 CLEANING AND ADJUSTMENT

a. Adjust operating hardware to function properly, without binding, and to provide tight fit at contact points and weather-stripping.

b. Clean completed system, inside and out, promptly after erection and installation of sealants. Remove excess sealant compounds, dirt, and other substances from surfaces.

c. Remove protective coating when completion of construction activities no longer requires its

retention.

END OF SECTION 08110

SECTION 08114

STANDARD STEEL DOORS

PART 1 GENERAL

1.1 SUMMARY

A. Related Sections:
   1. Section 08115 - Standard Steel Frames.
   2. Section 09900 - Paints and Coatings: Field painting of doors.

1.2 REFERENCES

A. American National Standards Institute:
   1. ANSI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.

B. ASTM International:
   1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   2. ASTM C1363 - Standard Test Method for the Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
   3. ASTM E413 - Standard Classification for Rating Sound Insulation.

C. Hollow Metal Manufacturers Association:
   1. HMMA 810 - Hollow Metal Doors.

D. Steel Door Institute:
   1. SDI 108 - Recommended Selection and Usage Guide for Standard Steel Doors.

1.3 SUBMITTALS

A. Shop Drawings: Indicate door elevations, internal reinforcement, closure method, and finishes.

B. Product Data: Submit door configurations, location of cut-outs for hardware reinforcement.

C. Manufacturer's Installation Instructions: Submit special installation instructions.

D. Manufacturer's Certificate: Certify meet or exceed specified requirements

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ANSI A250.8.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.

B. Installer: Company specializing in performing work of this section.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect doors with resilient packaging.

1.7 COORDINATION

A. Coordinate Work with door opening construction, door frame, and door hardware installation.

PART 2 PRODUCTS

2.1 STANDARD STEEL DOORS

A. Furnish materials in accordance with Public Work's standards.

B. Product Description:
   1. Interior Doors (Non-Rated): ANSI A250.8, SDI 108, 1-3/4 inch (44 mm) thick.
      a. Level 1 - Standard Duty, Model 1, full flush design.

2.2 COMPONENTS

A. Face: Steel sheet in accordance with ANSI A250.

B. End Closure: Channel, 0.04 inches (1.2 mm) thick, flush.

2.3 ACCESSORIES

A. Astragals for Double Doors: Steel, T shaped, specifically for double doors.

B. Primer: ANSI A250.10 rust inhibitive type.

2.4 FABRICATION

A. Fabricate doors with hardware reinforcement welded in place.

B. Attach astragal to one leaf of pairs of doors.

2.5 SHOP FINISHING

A. Steel Sheet: Galvanized to ASTM A653/A653M G60.

B. Primer: Baked.

C. Shop Finish: Baked enamel color as selected.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify opening sizes and tolerances are acceptable.

3.2 INSTALLATION

A. Install doors in accordance with ANSI A250.8.

B. Install door louvers, plumb and level.

C. Coordinate installation of doors with installation of frames specified in Section 08115 and hardware specified in Section 08712.

D. Touch-up damaged shop finishes.

3.3 ERECTION TOLERANCES

A. Maximum Diagonal Distortion: 1/8 inch measured with straight edge, corner to corner.

3.4 ADJUSTING

A. Adjust door for smooth and balanced door movement.

END OF SECTION 08114

SECTION 08115

STANDARD STEEL FRAMES

1.1 SUMMARY

A. Section includes non-rated steel frames.

B. Related Sections:
1. Section 03300 - Cast-In-Place Concrete: Placement of anchors into masonry wall construction.
2. Section 08114 - Standard Steel Doors.
3. Section 08712 - Finish Hardware

1.2 REFERENCES

A. American National Standards Institute:
1. ANSI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.

B. ASTM International:
1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

1.3 SUBMITTALS

A. Shop Drawings: Indicate frame elevations, reinforcement, anchor types and spacing, location of cut-outs for hardware, and finish.

B. Product Data: Submit frame configuration and finishes.

C. Manufacturer's Installation Instructions: Submit special installation instructions.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Conform to requirements of ANSI A250.8.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept frames on site in manufacturer's packaging. Inspect for damage.

B. Break seal on-site to permit ventilation.

1.7 COORDINATION

A. Coordinate Work with frame opening construction, door, and hardware installation.

PART 2 PRODUCTS

2.1 STANDARD STEEL FRAMES

1. Frames: To suit ANSI A250.8 Grade and Model of door specified in Section 08114.

2.2 ACCESSORIES

A. Primer: ANSI A250.10 rust inhibitive type.

B. Silencers: Specified in Section 08712.

C. Weatherstripping: Specified in Section 08712.

2.3 FABRICATION

A. Fabricate frames as for knock down field assembly.

B. Fabricate frames with hardware reinforcement plates welded in place.

C. Reinforce frames wider than 48 inches with roll formed steel channels fitted tightly into frame head, flush with top.

2.4 SHOP FINISHING

A. Steel Sheet: Galvanized to ASTM A653/A653M G60

B. Primer: Baked.

C. Factory Finish: Baked enamel of color as selected.

D. Coat inside of frame profile with bituminous coating to minimum thickness of 1/16 inch.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify opening sizes and tolerances are acceptable.

3.2 INSTALLATION

A. Install frames in accordance with ANSI A250.8.

B. Coordinate with concrete wall construction for anchor placement.

C. Coordinate installation of frames with installation of hardware specified in Section 08712 and doors in Section 08114.

D. Install roll formed steel reinforcement channels between two abutting frames. Anchor to structure and floor.

3.3 ERECTION TOLERANCES

A. Maximum Diagonal Distortion: 1/8 inch measured with straight edges, crossed corner to corner.

END OF SECTION 08115

SECTION 08712

FINISH HARDWARE

PART 1 GENERAL

1.1 DESCRIPTION

This Section provides specifications for the furnishing and delivery to the building site of all finishing hardware required for all doors, etc., complete as indicated on the drawings and as specified.

1.2 QUALITY ASSURANCE

A. Manufacturers shall be specialized in manufacturing door hardware with minimum three years experience.

B. The hardware manufacturer shall submit to the ENGINEER a written warranty against defects in materials and workmanship. The warranty shall cover a time period of two years after the date of final acceptance of the project. Defects in material and workmanship shall be corrected to the complete satisfaction of the OWNER at no cost.

1.3 SUBMITTALS

A. Submit schedule, shop drawings, and product date.

B. Provide product date on specified hardware.

1.4 DELIVERY, STORAGE, AND HANDLING

All hardware shall be delivered at the site, packed separately with all trimmings, screws, etc. for the particular door, all properly labeled and numbered so that they can be checked with the hardware list which shall be furnished with the goods when delivered.

PART 2 PRODUCTS

2.1 GENERAL

A. All hardware shall be of the best quality in construction, design, and finish and free from any defects. Any defective pieces shall be replaced by the CONTRACTOR at his own expense.

B. Hardware shall be of the manufacture, type, weight, function, and quality as shown by

factory numbers of equal.

C. Lockset strikes shall be furnished in accordance with the American Standard Association, Inc. Specifications A115.1, A115.2, and A115.3.

2.2 KEYING

Locks shall be keyed in sets or subsets as scheduled. Locks shall be furnished with the manufacturer's standard construction key system. Keys shall be supplied as follows:

Locks:	3 change keys each lock.
Master keyed sets:	3 keys each set.
Blank keys:	4 blank keys.

The keys shall be turned over to the ENGINEER properly tagged and designated as to location, and arranged in a container in sets or subset. Key cabinets shall be provided for each master key system.

2.3 LOCKS

A. To the maximum extent possible, locksets shall be the products of a single manufacturer.

B. Mortise Locks and Latchsets: Mortise locks and latchsets shall be conforming to ANSI A 156.13. Strikes for all mortise locks and latches (including deadlocks) shall conform to ANSI A115.1 except strikes for security doors shall be rectangular (without lip). Mortise-type locks and latches for doors 1-3/4 inches thick and over shall have adjustable bevel fronts or otherwise conform to the shape of the door. Mortise locks shall have armored fronts.

C. Bored Lock and Latchets: Bored lock and latchsets shall conform to ANSI A156.2 Grade 1. Strikes for bored locks and latches shall conform to ANSI A115.2. Bored-type locks and latches for doors 1-3/8 inches thick and over shall have adjustable bevel fronts or otherwise conform to the shape of the door.

D. Interconnected Locks & Latches: Interconnected locks and latches shall conform to ANSI A156.12. Strikes and cut-outs for interconnected locks and latches shall conform to individual manufacturer's specifications. Interconnected locksets shall have a mechanically interconnected locking mechanism having a separate latch bolt or dead locking latch bolt.

2.4 FASTENINGS

A. The CONTRACTOR shall furnish necessary screws, bolts, and other fastenings for proper application of hardware. Fastenings shall be of suitable size and type of securing hardware as to material and finish.

B. The CONTRACTOR shall furnish necessary expansion shields, toggle bolts, machine screws, or other suitable approved anchoring devices where hardware is to be installed on concrete, masonry, or other types of backing.

2.5 BOLTS

Two pairs of butts shall be provided for each door. Butts for interior doors shall be 4 by 4 inches stainless steel, 130 gage. Butts for exterior doors shall be 4-1/2 by 4-1/2 inch stainless steel, 180 gage, with nonremovable stainless steel pins and two permanently lubricated nondetachable ball races.

2.6 CLOSERS

Closers shall be provided on all exterior doors and shall be sizes as recommended by the manufacturer. If larger size closers are required due to wind or mechanical ventilation, the hardware supplier shall be responsible. Closers must have a five year factory guarantee.

2.7 WEATHERSTRIPPING

Weatherstripping for all exterior doors shall be the compression type consisting of a solid vinyl strip and bulb secured in an extruded aluminum frame for heads and jambs.

2. 8 AUXILIARY HARDWARE

A. Auxiliary Hardware shall conform to ANSI A 156.16 as indicated on the drawings and as approved by the ENGINEER.

B. Lever Extension Flush bolts: Shall be provided at the top and bottom of the inactive leaf of pairs of doors and shall be mortised in the lock edge of the door.

PART 3 EXECUTION

3.1 INSTALLATION

Install hardware in accordance with manufacturer's printed instruction. Provide machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Provide toggle bolts where required for fastening to hollow core construction. Provide through bolts where necessary for satisfactory installation.

A. Threshold Installation: Extend thresholds the full width of the opening and notch end of jamb stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws in expansion sleeves.

3.2 HARDWARE LOCATIONS

ANSI/SDI 100, unless indicated or specified otherwise.

3.3 FIELD QUALITY CONTROL

After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the Owner. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the Owner. Correct, repair, and finish, as directed, errors in cutting and fitting and damage to adjoining work.

END OF SECTION 08712

SECTION 09212

PLASTERING

PART 1 GENERAL

1.1 SCOPE

This section includes Portland cement plastering complete.

a. General: Plastering work shall be properly coordinated with the work of other trades. The work of other trades shall be adequately protected from damage during plastering operations. Finished work shall be protected with a covering of heavy Kraft waterproof paper or other approved protective covering with lapped and sealed joints. Plastered surface to which rubber or vinyl base will be applied shall extend to and be finished square with the floor.

PART 2 MATERIALS

2.1 MATERIALS

Manufactured materials shall be delivered in the manufacturer's original unbroken packages or containers which are labeled plainly with the manufacturer's names and brands. Plaster and other cementitious materials shall be kept dry until ready to be used; they shall be stored off the ground, under cover, and away from sweating walls and other damp surfaces.

2.2 REQUIREMENTS

a. Portland cement shall be type 1, conforming to specification ANSI A42.2 Portland cement shall conform to the applicable requirements thereof and shall be nonstaining.

b. Hydrated lime for finish coat work shall be type S conforming to ASTM Specification C206.

c. Sand for Portland cement finish shall conform to ASTM Specification C144 and shall be natural in color or conforming to the local Government of Guam standards.

d. Water for mixing shall be potable.

2.3 MIXING OF PLASTER

Plaster materials specified on a volume basis shall be measured accurately in approved containers that

insure the specified proportions will be controlled and maintained accurately during the progress of the work. Measuring materials with shovels (shovel count) will not be permitted except finish coat containing lime may be hand mixed.

a. Base coat proportions: Scratch and brown coats of Portland cement plaster shall be mixed in the proportion of one part of volume of Portland cement to not more than 1/2 part of hydrated lime and not less than 3 nor more than 4 parts by volume of damp loose sand.

b. Finish coat proportions: Portland cement plaster finish shall be of the same proportion as the base coat.

2.4 PREPARATION FOR PLASTERING

a. Temperature and ventilation: A uniform temperature shall be maintained continuously in the areas to be plastered. This uniform temperature shall be maintained for not less than one week prior to the application of plaster, while the plastering is being done, while the plaster is drying and after the plaster is dry until normal occupancy conditions are established.

b. Preparation of bases: Surfaces to which plaster is to be applied shall be clean of all projections, dust, loose, particles, grease, bond breaker, and other foreign matter.

2.5 APPLICATION OF PLASTER

Plaster may be applied by hand or machine. When a plastering machine is used, the plaster fluidity shall be controlled to have a plaster slump of not more than nine inches when tested in a concrete slump testing apparatus of the type specified in ASTM C143.

a. Workmanship: Plaster shall be applied in three coats, except as follows:

1) The two-coat double-up method may be employed on masonry.

b. Portland cement plaster shall be applied to masonry, or rough new concrete surface. Base coats shall be applied with sufficiently plastic to provide good bond on masonry or concrete bases. Plaster shall be applied in three coats to a thickness of not less than 7/8 inch.

1) Scratch coat shall be applied approximately 3/8 inch thick. Before mortar has set, the surface shall be cross scratched to provide a suitable bond for brown coat.

2) Brown coat shall be applied over the dampened scratch coat approximately 3/8 inch thick and straightened with rod or float. Before mortar has set, the surface shall be cross-scratched to provide bond for finish coat. The brown coat shall be allowed to set

hard before the finish coat is applied.

3) Finish coat shall be applied over dampened brown coat to a thickness of approximately 1/8 inch. The finished surface shall be true and even and uniformly finished.

4) Curing and protection. Damp curing shall begin as soon as the mortar has hardened sufficiently to prevent injury and water applied in a fine fog spray to keep the plaster damp throughout without soaking. The periods for damp-curing shall be 48 hours for scratch coat and not less than 7 days each for brown coat and finish coat. Protect the plaster from uneven and excessive evaporation during hot or drying weather conditions.

2.6 PATCHING AND POINTING

Upon completion of the building and when directed, all loose, cracked, and damaged or defective plastering shall be cut out and replastered in a satisfactory and approved manner. All pointing and patching of plastered surfaces, and plater work abutting or adjoining any other finished work, shall be done in a neat and workmanlike manner. Plaster droppings or spatterings shall be removed from all surfaces. Exposed plastered surfaces shall be left in a clean unblemished condition ready to receive paint or other finish. Protective covering shall be removed from floors and other surfaces, and all rubbish and debris shall be removed from the building.

END OF SECTION 09212

SECTION 09900

PAINTING

PART 1 GENERAL

1.1 SCOPE OF WORK

Works included under this Section consist of:

a. Cleaning (washing) the inside and outside of the building, walls, ceilings and roof.

b. Painting of all new walls and ceiling, inside and outside of the control building.

The CONTRACTOR shall furnish all materials, tools and equipment, and shall do all painting work specified herein, or otherwise specified or indicated on the Drawings. All facilities, whether existing or new shall be painted.

1.2 QUALITY OF WORK

All finishes shall be applied by skilled workmen in accordance with the best practices and standards of the painting trade. Brushes, rollers, all equipment, and the techniques used in applying finishes shall be of sufficient quality to assure the specified results. Work not conforming to this specification shall be corrected by touching up or refinishing as directed by the ENGINEER.

1.3 SUBMITTALS

In accordance with the submittal requirements, submit the following:

a. Manufacturer's data for all Paint

b. Painting Schedule

c. Color Samples

1.4 DELIVERY AND STORAGE

Painting materials shall be delivered to site in manufacturer's original containers with label intact and seals unbroken. Painting materials and equipment shall be stored and mixed in rooms assigned for that purpose. All necessary precautions shall be taken to prevent fire. Rags or waste soiled with paint shall

be removed from premises at end of each day's work, or shall be stored in covered metal containers.

1.5 REFERENCE STANDARD OF QUALITY

a. The painting specifications and paint finish schedule lists products by brand name to a standard of quality. Products of other manufacturers may be accepted in place of those specified upon proof of equivalency in accordance with of the General Provisions, as modified by the Special Provisions and this section.

b. If the CONTRACTOR desires to use other than specified products, he shall submit an itemized list giving the manufacturer's name, and the specific name and number of each product offered as a substitute and such other information as is necessary to enable the ENGINEER to evaluate substitute products. Approval of substitute products shall be obtained from the ENGINEER before any materials are applied. Unspecified materials, such as turpentine and paint thinner shall be pure and of the highest quality of an approved manufacturer and shall bear the manufacturer's label on each container or package. All materials shall be delivered to the job site in the original containers with contents and labels intact.

1.6 PRELIMINARY EXAMINATION

Notify the ENGINEER in writing of any uncorrected defects in surfaces to be painted. Do not proceed with the finishing of surfaces in question until any discrepancies are corrected. The starting of work on any surface shall imply that the surface has been inspected and approved by the CONTRACTOR.

PART 2 MATERIALS

2.1 GENERAL

a. All paint shall be the product of a recognized manufacturer exclusively engaged in the manufacture of painting material. All paints for wood and metal surfaces shall be well ground and shall not skin, liver, curdle, or body excessively in the containers. It shall be readily stirred with a paddle to a smooth uniform paint.

b. The paint shall be suitable for brushing at package consistency. It shall brush out evenly and shall not show laps or unevenness of color or texture. When applied to vertical surfaces, it shall not sag.

c. All exposed surfaces, including sides and edges, shall be painted. Hangers brackets, fastenings and other miscellaneous items shall be painted with the same system as the adjacent material. Paint systems shall be in addition to shop primers.

d. Paint used in successive field coats shall be produced by the same manufacturer. Paint used in the first field coat over shop painted or previously painted surfaces shall cause no wrinkling, lifting, or other damage to underlaying paint. Any paint system shall be the product of a single manufacturer.

e. All paint used for intermediate and finish coats shall be guaranteed by the paint manufacturer to be lead-free, mercury-free, and fumeproof. Where painting materials are referenced to Federal or Military Specifications, the reference shall define general type and quality required but is not intended to limit acceptable materials to an exact formulas.

f. For each paint, the CONTRACTOR shall follow the paint manufacturer's specific application instructions. Upon the ENGINEER's request, the CONTRACTOR shall furnish the following application instructions:

1) Surface preparation recommendations.

2) Type of primer to be used.

3) Maximum dry and wet mil thickness per coat.

4) Minimum and maximum curing times between coats.

5) Thinner to be used with each paint.

6) Ventilation requirements.

7) Atmospheric conditions during which the paint shall not be applied.

8) Allowable methods of application.

9) Maximum allowable moisture content and minimum age of plaster, concrete and wood surfaces at time of paint application.

10) Curing time before submergence in water.

g. The minimum number of coats and minimum total dry mil thickness of the system for each surface shall be as specified in the paint schedule.

2.2 PAINTING SCHEDULE

a. Interior Concrete Masonry and Concrete Surfaces

Surface Prep	M-1
Prime Coat	P-4
Second Coat	F-6
Third Coat	F-6

b. Exterior Concrete/Block Concrete

Surface Prep	M-1
Prime Coat	F-4
Second Coat	F-4
Third Coat	F-8

2.3 PRIMERS AND PRETREATMENT

P-1 Epoxy Primer - Minimum dry thickness 1.5 mils. Koppers 654 "Epoxy Primer", Tnemec 661211 " Hi-Build Expoxoline", or Amerguard 149 Epoxy Primer.

P-2 Rust Inhibitive - Minimum dry thickness 2 mils. Koppers 622 "Rust-Penetrating" Tnemec 77 "Chem-Prime", or Amerguard 149 "Epoxy Primer".

P-3 Galvanized Metal Wash Primer - Minimum dry thickness 0.5 mils (mil-P-15328D). Galvaprep, Koppers 40 "Passivator" or Tnemec 32-1210 "Vinoline".

P-4 Acrylic Emulsion - Kopper "Surfacer", Tnemec 51 792 "Vinacryl Primer-sealer", or Amerguard 149.

2.4 INTERMEDIATE AND FINISH PAINTS

F-1 Epoxy Resin - Minimum dry thickness 6 mils. Koppers "200 HB Epoxy", Tnemec 66 "Hibuild" epoxy, or Amerguard 335 "Epoxy Acrylic".

F-2 Gloss Alkyd Enamel - Minimum dry thickness 1.5 mils (Fed Spec TT-E-489). Koppers "Glamortex 501" enamel, Tnemec-gloss" enamel, or Amerguard 335 "Epoxy Acrylic".

F-3 Semigloss Alkyd Enamel - Minimum dry thickness 2.1 mils (Fed Spec TT-E-529). Koppers "Glamortex Semi-gloss", Tnemec 23 "Enduraton", or Amerguard 335 "Epoxy Acrylic".

F-4 Latex Emulsion - Minimum dry thickness 2 mils. Koppers "600 - Interior, Exterior", Tnemec "6

Tneme - Cryl", or Amerguard 335 Epoxy Acrylic.

F-5 Coal Tar Epoxy - Minimum dry thickness 16 mils. Koppers "Bitumastic 300M" High Build, Tnemec "High Build Tneme-Tar", or Amercoat 78HB.

F-6 Epoxy - Minimum dry thickness 1.75 mils. Koppers "Glamorglass 200 Epoxy", or Amerguard 335 "Epoxy Acrylic".

F-7 Polyurethane - Minimum dry thickness 2 mils. Tnemec "70 Endurashield", or Amercoat 455HS.

F-8 Copolymer - Minimum dry thickness 2 mils. Rainguard Products Company "Vandl Guard".

2.5 SURFACES NOT TO BE PAINTED

Except as otherwise required or directed, the following surfaces are to be left unpainted:

a. Exposed surfaces of aluminum, except ductwork. Polished or finished stainless steel. Unfinished stainless steel shall be painted.

b. Nickel or chromium.

c. Rubber and plastics, including fiberglass reinforced plastics.

PART 3 PERFORMANCE

3.1 SURFACE PREPARATION

a. The CONTRACTOR shall prepare the existing and new surfaces to be coated as specified under the paint schedule. Any surfaces to be coated which are not listed under the paint schedule shall be prepared in accordance with the manufacturer's instructions for the material to apply.

b. In addition, all exterior and interior surfaces shall be washed with a stiff bristle brush and mild alkaline solution to be approved by the ENGINEER. No high pressure water shall be used during the preparation work and during the cleaning work, unless approved by ENGINEER.

c. All grease, oil, dirt, and other contaminants which may affect the bond between the coating and the surface shall be removed by a cleaning agent which leaves the surface clean and dry.

d. Cleaning and painting operations shall be performed in a manner which will prevent dust or

other contaminants from getting on freshly painted surfaces.

e. Surfaces shall be free of cracks, pits, projections, or other imperfections which would prevent the formation of a smooth, unbroken paint film, except for concrete block construction where a rough surface is an inherent characteristic.

f. When applying touch-up paint or repairing previously painted surfaces, the surfaces to be painted shall be cleaned and sanded or wire brushed in such a manner that the edges of adjacent paint are feathered or otherwise smoothed so that they will not be noticeable when painted. All paint made brittle or otherwise damaged by heat or welding shall be completely removed.

g. Hardware items such as bolts, screws, washers, springs, and grease fittings need not for cleaned prior to painting if there is no evidence of dirt, corrosion, or foreign material.

h. All galvanized surfaces shall have a metal conditioner applied prior to the first prime coat.

3.2 METAL SURFACES

Where noted, the surface preparation for steel and other metals refer to the specifications for surface preparation by the latest revision of the Steel Structures Painting Council. All metal work shall be cleaned of greased, oil and dirt by solvent cleaning (SSPC-SP-1).

Method S-1 - Surface shall be wire brushed where required to remove loose rust and dirt, etc. (SSPC-SP2)

Method S-2 - Removal of loose rust, loose mill scale and other detrimental foreign matter to degree specified by power wire brushing, power impact tools or power sanders. (SSPC-SP3)

Method S-3 - Blast cleaning until at least two-thirds of each element of surface area is free of all visible residue. (SSPC-SP6)

Method S-4 - SandBlast to near-white condition. This method shall remove all rust and scale, but streaks and shadows in the metal will be acceptable (SSPC-SP10).

3.3 MASONRY AND CONCRETE SURFACE

a. Method M-1 Remove all dust and loose mortar by sweeping, or brushing with a stiff fiber or wire brush. Concrete and masonry surfaces that show signs of efflorescent or that are subject to conditions with Dutch Boy Alki-Free, Thoro System Products "Waterplug", or equivalent product, according to manufacturer's recommendation.

b. All surface defects, including cracks 1/1 6-inch to hairline shall be filled flush by knifing with an exterior masonry patching compound. Cracks of more than 1/16-inch wide shall be cleaned out to an inverted "V" and pressure filled with an exterior masonry patching compound. Fill with a slight bead.

c. Dirt, grease, from oils or separating agents that might impair the adhesions or the appearance of the specified finish shall be removed before any materials are applied.

d. Voids and openings in concrete block construction shall be filled with Thoro System Products "Thoroseal Plaster Mix", or equivalent product, according to manufacturer's recommendations.

e. Concrete surface shall be sand-blasted and/or acid-washed as recommended by coating manufacturer.

3.4 GALVANIZED SURFACES

Method G-1- All galvanized surfaces shall be prepared for painting in strict conformity with the instructions of the manufacturer of the vinyl wash primer. Any subsequent primer required by the coating manufacturer for the finish coating shall be applied. Any chemical treatment of galvanized surfaces shall be followed by thorough rinsing with clear water.

3.5 PAINT APPLICATION

a. Apply all finishes evenly, free from sags, runs, crawls, brush marks, skips or other defects. Apply products at the proper consistency and do not thin or otherwise alter them except in accordance with the manufacturer's printed directions. All coats shall be applied in such manner as to produce an even film of uniform thickness completely coating all corners and crevices. All painting shall be done by thoroughly experienced workmen. Care shall be exercised during spraying to hold the nozzle sufficiently close to the surfaces being painted to avoid excessive evaporation of the volatile constituents and loss of material into the air, or the bridging over of crevices and corners. Spray equipment shall be equipped with mechanical agitators, pressure gauges, and pressure regulators. Nozzles shall be of proper size. Floors, roofs, and other adjacent areas and installations shall be satisfactorily protected by drop cloths or other precautionary measures.

   All over-spray shall be removed by approved methods or the affected surface repainted. Care shall be exercised to avoid lapping of paint on hardware of other unscheduled surfaces.

b. Each coat of material shall be thoroughly dry before the application of a succeeding coat. In no case shall paint be applied at a rate of coverage per gallon which is greater than the maximum rate recommended by the manufacturer. Paint films showing sags, checks, blisters, teardrops, or fat edges will not be accepted. Paint containing any of these defects shall be entirely removed and the surface repainted.

c. If the finish coat is to be colored, the prime coat and the intermediate coat shall be tinted to have a slight variation in color from each other and from the finish coat.

3.6 PRIMING

a. Edges, corners, crevices, welds, and bolts shall be given a brush coat of primer before the specified spot or touch-up painting of metal surfaces. Special attention shall be given to filling crevices with paint.

b. Abraded and otherwise damaged portions of shop applied paint shall be repainted. Welded seams and other uncoated surfaces, heads, and nuts of field installed bolts, and surfaces where paint has been damaged by heat, shall be given a coat of the specified primer. This patch, spot, or touch-up painting shall be completed, and shall be dry and hard, before additional paint is applied.

3.7 LATEX PAINT

Latex paint shall be applied by brushing or rolling; spraying is not permitted. Latex paint shall not be thinned excessively.

3.8 MIXING AND THINNING

Paint shall be thoroughly mixed each time any is withdrawn from the container. Paint containers shall be kept tightly closed except while paint is being withdrawn. Unless otherwise authorized, all paint shall be factory mixed to proper consistency and viscosity for hot weather application without thinning. Thinning will be permitted only as necessary to obtain recommended coverage at lower application temperatures. In no case shall the wet film thickness of applied paint be reduced, by addition of paint thinner or otherwise, below that represented by the recommended coverage rate.

3.9 FERROUS METAL FILM THICKNESS

It is intended that the dry film thickness and the continuity of submerged painted ferrous metal surfaces be subject to continual field check by the ENGINEER. Dry film thickness shall be measured by a General Electric Thickness Gauge. Continuity shall be tested by a low voltage-wet sponge, transistorized device as manufactured by the K-D Company, Palo Alto, California. CONTRACTOR shall

perform continuity tests as required by the ENGINEER.

3.10 ATMOSPHERE CONDITIONS

Apply all material to dry and properly prepared surfaces when weather conditions are favorable for painting. No materials shall be applied when the temperature of the materials is below 50 degrees Fahrenheit, or when the temperature of the air, surface to be painted or substrate, is below (or likely to fall below) 50 degrees Fahrenheit. Final ruling on the favorability of weather conditions shall be in accordance with the recommendations of the manufacturer and/or the ENGINEER.

3.11 PROTECTION OF SURFACE

Throughout the work the CONTRACTOR shall use drop cloths, masking tape, and other suitable measures to protect all surfaces from accidental spraying, splattering, or spilling of paint. He shall be liable for and shall correct and repair any damaged condition resulting from his operations or from the operations of all those who are responsible to him during the time his work is in progress and until the work is accepted. In case bituminous paints are spilled or dropped on any material except metals, the spots shall, after surface cleaning, be spot painted with aluminum paint prior to applying the specified paint. Any exposed concrete or masonry not specified to be painted which is damaged by paint shall be either removed and rebuilt or, where so authorized by the OWNER, painted with two coats of masonry paint.

3.12 CLEAN-UP

All cloths and cotton waste which might constitute a fire hazard shall be placed in metal containers or destroyed at the end of each work day. Upon completion of the work all staging, scaffolding and containers shall be removed from the site or destroyed in a manner approved by the ENGINEER.

END OF SECTION 09900

SECTION 13283

REMOVAL/CONTROL AND DISPOSAL OF PAINT WITH LEAD

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

A. ANSI Z88.2(1992) Respiratory Protection

B. U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD)

C. HUD 6780(1995; Errata Aug 1996;Rev Ch. 7 - 1997) Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

A. 29 CFR 1926.103Respiratory Protection

B. 29 CFR 1926.21Safety Training and Education

C. 29 CFR 1926.33Access to Employee Exposure and Medical Records

D. 29 CFR 1926.55Gases, Vapors, Fumes, Dusts, and Mists

E. 29 CFR 1926.59Hazard Communication

F. 29 CFR 1926.62Lead

G. 29 CFR 1926.65Hazardous Waste Operations and Emergency Response

H. 40 CFR 260Hazardous Waste Management System: General

I. 40 CFR 261Identification and Listing of Hazardous Waste

J. 40 CFR 262Standards Applicable to Generators of Hazardous Waste

K. 40 CFR 263Standards Applicable to Transporters of Hazardous Waste

L. 40 CFR 264Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities

M. 40 CFR 265Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities

N. 40 CFR 268Land Disposal Restrictions

O. 40 CFR 745Lead-Based Paint Poisoning Prevention in Certain Residential Structures

P. 49 CFR 172Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements

Q. 49 CFR 178Specifications for Packagings

UNDERWRITERS LABORATORIES (UL)

A. UL 586(1996; Rev thru Apr 2000) High-Efficiency, Particulate, Air Filter Units

1.2 DEFINITIONS

1.2.1 Abatement

As applied to target housing and child occupied facilities, "abatement" means any set of measures designed to permanently eliminate lead-based paint hazards in accordance with standards established by appropriate Federal agencies. Such term includes:

a. The removal of lead-based paint and lead-contaminated dust, the permanent containment or encapsulation of lead-based paint, the replacement of lead-painted surfaces or fixtures, and the removal or covering of lead contaminated soil; and

b. All preparation, cleanup, disposal, and post-abatement clearance testing activities associated with such measures.

1.2.2 Action Level

Employee exposure, without regard to use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air averaged over an 8 hour period in a work environment.

1.2.3 Area Sampling

Sampling of lead concentrations within the lead control area and inside the physical boundaries, which is representative of the airborne lead concentrations but is not collected in the breathing zone of personnel.

1.2.4 Child Occupied Facility

A building or portion of a building constructed prior to 1978 visited regularly by the same child, 6 years of age or under, on a least two different days within any week, provided each days visit last at least 3 hours and the combined weekly visit last at least 6 hours and the combined annual visit last at least 60 hours. Child occupied facilities may include, but are not limited to day-care centers, preschools and kindergarten classrooms.

1.2.5 Competent Person (CP)

As used in this section, refers to a person employed by the Contractor who is trained in the recognition and control of lead hazards in accordance with current federal, State, and local regulations. A Certified Industrial Hygienist (CIH) certified for comprehensive practice by the American Board of Industrial Hygiene or a Certified Safety Professional (CSP) certified by the Board of Certified Safety Professionals is the best choice.

1.2.6 Contaminated Room

Refers to a room for removal of contaminated personal protective equipment (PPE).

1.2.7 Decontamination Shower Facility

That facility that encompasses a clean clothing storage room, and a contaminated clothing storage and disposal rooms, with a shower facility in between.

1.2.8 Deleading

Activities conducted by a person who offers to eliminate lead-based paint or lead-based paint hazards or to plan such activities in commercial buildings, bridges or other structures.

1.2.9 Eight-Hour Time Weighted Average (TWA)

Airborne concentration of lead to which an employee is exposed, averaged over an 8 hour workday as indicated in 29 CFR 1926.62.

1.2.10 High Efficiency Particulate Air (HEPA) Filter Equipment

HEPA filtered vacuuming equipment with a UL 586 filter system capable of collecting and retaining lead-contaminated paint dust. A high efficiency particulate filter means 99.97 percent efficient against 0.3 micron or larger size particles.

1.2.11 Housing Unit

A housing unit shall be defined as a single structure located within the subject site.

1.2.12 Lead

Metallic lead, inorganic lead compounds, and organic lead soaps.

1.2.13 Lead-Based Paint (LBP)

Paint or other surface coating that contains lead in excess of 1.0 milligrams per centimeter squared or 0.5 percent by weight.

1.2.14 Lead-Based Paint Activities

In the case of target housing or child occupied facilities, lead-based paint activities include; a lead-based paint inspection, a risk assessment, or abatement of lead-based paint hazards.

1.2.15 Lead-Based Paint Hazard (LBP Hazard)

Any condition that causes exposure to lead from lead-contaminated dust, lead-contaminated soil, lead-based paint that is deteriorated or present in accessible surfaces, friction surfaces, or impact surfaces that would result in adverse human health effects.

1.2.16 Paint with Lead (PWL)

Any paint that contains lead as determined by the testing laboratory using a valid test method. The requirements of this section does not apply if no detectable levels of lead are found using a quantitative method for analyzing paint using laboratory instruments with specified limits of detection (usually 0.01%). An X-Ray Fluorescence (XRF) instrument is not considered a valid test method.

1.2.17 Lead Control Area

A system to prevent the spread of lead dust, paint chips or debris to adjacent areas that may include temporary containment, floor or ground cover protection, physical boundaries, and warning signs to prevent unauthorized entry of personnel. HEPA filtered local exhaust

equipment may be used as engineering controls to further reduce personnel exposures or building/outdoor environmental contamination.

1.2.18 Lead Permissible Exposure Limit (PEL)

Fifty micrograms per cubic meter of air as an 8 hour time weighted average as determined by 29 CFR 1926.62. If an employee is exposed for more than eight hours in a workday, the PEL shall be determined by the following formula:

PEL (micrograms/cubic meter of air) = 400/No. hrs worked per day

1.2.19 Personal Sampling

Sampling of airborne lead concentrations within the breathing zone of an employee to determine the 8 hour time weighted average concentration in accordance with 29 CFR 1926.62. Samples shall be representative of the employees' work tasks. Breathing zone shall be considered an area within a
hemisphere, forward of the shoulders, with a radius of 6 to 9 inches and centered at the nose or mouth of an employee.

1.2.20 Physical Boundary

Area physically roped or partitioned off around an enclosed lead control area to limit unauthorized entry of personnel. As used in this section, "inside boundary" shall mean the same as "outside lead control area but inside the physical boundary."

1.2.21 Target Housing

Housing constructed prior to 1978. It does not include housing for the elderly, or persons with disabilities unless any one or more children age 6 years and younger resides or is expected to reside in such housing.

1.2.22 Toxicity Characteristic Leaching Procedure (TCLP)

Laboratory testing procedure summarized in EPA SW-864 Manual that is designed to simulate leaching a material may undergo if disposed in a sanitary landfill in order to determine whether the tested material possesses the characteristic of toxicity to an extent that defines it as a hazardous waste.

1.3 DESCRIPTION

1.3.1 Description of Work

Remove/control lead-based paint / paint with lead, located at the X-221 pad within the Dedeo substation compound. All other area pads and support structures within the area to be demolished have been determined to be free of LBP above regulatory levels.

OSHA has determined that workers performing these tasks may be exposed to airborne lead levels which exceed the permissible exposure limit (PEL). Until an exposure assessment has been complete that indicates the lead exposure levels are below the PEL the contractor shall follow the requirements contained in this specification.

1.4 SUBMITTALS

Product Data

Vacuum Filters

Respirators

Test Reports

sampling results

Occupational and Environmental Assessment Data Report

Certificates

Qualifications of CP;

Testing Laboratory qualifications

Lead-based paint/paint with lead removal/control plan including CP approval (signature, date, and certification number)

Rental equipment notification

Respiratory Protection Program

Hazard Communication Program;

State approved hazardous waste treatment, storage, or disposal facility for lead disposal

Lead Waste Management Plan

Vacuum filters

Manufacturer's Instructions

Chemicals and equipment;

Materials;

Material safety data sheets for all chemicals

Closeout Submittals

Completed and signed hazardous waste manifest from treatment or disposal facility

Certification of Medical Examinations

Employee Training Certification

Waste turn-in documents or weight tickets for non-hazardous wastes that are disposed of at sanitary or construction and demolition landfills

1.5 QUALITY ASSURANCE

1.5.1 Qualifications

1.5.1.1 Qualifications of CP

Submit name, address, and telephone number of the CP selected to perform responsibilities specified in paragraph entitled "Competent Person (CP) Responsibilities." Provide previous experience of the CP. Submit proper documentation that the CP is trained and certified in accordance with Federal, State, and local laws.

1.5.1.2 Training Certification

Submit a certificate for each employee and supervisor, signed and dated by the training provider meeting 40 CFR 745 (Subpart L) requirements, stating that the employee or supervisor has received the required lead training and is certified to perform or supervise deleading or lead removal.

1.5.1.3 Testing Laboratory

Submit the name, address, and telephone number of the testing laboratory selected to perform the air and soil sampling, testing, and reporting of airborne concentrations of lead. Use a laboratory accredited under the EPA National Lead Laboratory Accreditation Program (NLLAP) by either the American Association for Laboratory Accreditation (A2LA) or the American Industrial Hygiene Association (AIHA) and that is successfully participating in the Environmental Lead Proficiency Analytical Testing (ELPAT) program to perform sample analysis. Laboratories selected to perform blood lead analysis shall be OSHA approved.

1.5.1.4 Third Party Consultant Qualifications

Submit the name, address, and telephone number of the third party consultant selected to perform the wipe sampling for determining concentrations of lead in dust or soil sampling. Submit proper documentation that the consultant is trained and certified as an inspector technician or inspector/risk assessor by the USEPA authorized State (or local) certification and accreditation program.

1.5.2 Requirements

1.5.2.1 Competent Person (CP) Responsibilities

a. Verify training meets all federal, State, and local requirements.

b. Review and approve lead-based paint/paint with lead removal/control plan for conformance to the applicable standards. Ensure work is performed in strict accordance with specifications at all times.

c. Continuously inspect lead-based paint removal/control work for conformance with the approved plan.

d. Perform air and wipe sampling.

e. Control work to prevent hazardous exposure to human beings and to the environment at all times.

f. Certify the conditions of the work as called for elsewhere in this specification.

1.5.2.2 Lead-Based Paint/Paint with Lead Removal/Control Plan (LBP/PWL R/CP)

Submit a detailed job-specific plan of the work procedures to be used in the removal/control of LBP/PWL. The plan shall include a sketch showing the location, size, and details of lead control areas, location and details of decontamination

facilities, viewing ports, and mechanical ventilation system. Include a description of equipment and materials, controls and job responsibilities for each activity from which lead is emitted. Include in the plan, eating, drinking, smoking and sanitary procedures, interface of trades, sequencing of lead related work, collected waste water and paint debris disposal plan, air sampling plan, respirators, personal protective equipment, and a detailed description of the method of containment of the operation to ensure that lead is not released outside the lead control area. Include site preparation, cleanup and clearance procedures. Include occupational and environmental sampling, training, sampling methodology, frequency, duration of sampling, and qualifications of sampling personnel in the air sampling portion of the plan. Include a description of arrangements made among contractors on multi-contractor worksites to inform affected employees and to clarify responsibilities to control exposures.

The Removal/Control Plan shall be developed by a certified planner/project designer.

1.5.2.3 Occupational and Environmental Assessment Data Report

If initial monitoring is necessary, submit occupational and environmental sampling results to the Contracting Officer within three working days of collection, signed by the testing laboratory employee performing the analysis, the employee that performed the sampling, and the CP.

a. The initial monitoring shall represent each job classification, or if working conditions are similar to previous jobs by the same employer, provide previously collected exposure data that can be used to estimate worker exposures per 29 CFR 1926.62. The data shall represent the worker's regular daily exposure to lead for stated work.

b. Submit worker exposure data gathered during the task based trigger operations of 29 CFR 1926.62 with a complete process description. This includes manual demolition, manual scraping, manual sanding, heat gun, power tool cleaning, rivet busting, cleanup of dry expendable abrasives, abrasive blast enclosure removal, abrasive blasting, welding, cutting and torch burning where lead containing coatings are present.

c. The initial assessment shall determine the requirement for further monitoring and the need to fully implement the control and protective requirements including the lead compliance plan per 29 CFR 1926.62.

1.5.2.4 Medical Examinations

Initial medical surveillance as required by 29 CFR 1926.62 shall be made available to all employees exposed to lead at any time (1 day) above the action level. Full medical surveillance shall be made available to all employees on an annual basis who are or may be exposed to lead in excess of the action level for more than 30 days a year or as required by 29 CFR 1926.62. Adequate records shall show that employees meet the medical surveillance requirements of 29 CFR 1926.33, 29 CFR 1926.62, and 29 CFR 1926.103. Maintain complete and accurate medical records of employees for a period of at least 30 years or for the duration of employment plus 30 years, whichever is longer.

1.5.2.5 Training

Train each employee performing paint removal, disposal, and air sampling operations prior to the time of initial job assignment and annually thereafter, in accordance with 29 CFR 1926.21, 29 CFR 1926.62, and State and local regulations where appropriate.

1.5.2.6 Respiratory Protection Program

a. Provide each employee required to wear a respirator a respirator fit test at the time of initial fitting and at least annually thereafter as required by 29 CFR 1926.62.

b. Establish and implement a respiratory protection program as required by ANSI Z88.2, 29 CFR 1926.103, 29 CFR 1926.62, and 29 CFR 1926.55.

1.5.2.7 Hazard Communication Program

Establish and implement a Hazard Communication Program as required by 29CFR 1926.59.

1.5.2.8 Lead Waste Management

The Lead Waste Management Plan shall comply with applicable requirements of federal, State, and local hazardous waste regulations and address:

a. Identification and classification of hazardous wastes associated with the work.

b. Estimated quantities of wastes to be generated and disposed of.

c. Names and qualifications of each contractor that will be transporting, storing, treating, and disposing of the wastes. Include the facility location and a 24-hour point of contact. Furnish two copies of proof of State hazardous waste manifests.

d. Names and qualifications (experience and training) of personnel who will be working on-site with hazardous wastes.

e. List of waste handling equipment to be used in performing the work, to include cleaning, volume reduction, and transport equipment.

f. Spill prevention, containment, and cleanup contingency measures including a health and safety plan to be implemented in accordance with 29 CFR 1926.65.

g. Work plan and schedule for waste containment, removal and disposal. Wastes shall be cleaned up and containerized daily. Proper containment of the waste includes using acceptable waste containers (e.g., 55-gallon drums) as well as proper marking/labeling of the containers.

h. Unit cost for waste disposal according to this plan.

1.5.2.9 Environmental, Safety and Health Compliance

In addition to the detailed requirements of this specification, comply with laws, ordinances, rules, and regulations of Federal, State, and local authorities regarding removing, handling, storing, transporting, and disposing of lead waste materials. Comply with the applicable requirements of the current issue of 29 CFR 1926.62. Submit matters regarding interpretation of standards to the Contracting Officer for resolution before starting work. Where specification requirements and the referenced documents vary, the most stringent requirement shall apply.

1.5.3 Pre-Construction Conference

Along with the CP, meet with the Contracting Officer to discuss in detail the lead waste management plan and the lead-based paint/paint with lead removal/control plan, including work procedures and precautions for the removal plan.

1.6 EQUIPMENT

1.6.1 Respirators

Furnish appropriate respirators approved by the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services, for use in atmospheres containing lead dust. Respirators shall comply with the requirements of 29 CFR 1926.62.

1.6.2 Special Protective Clothing

Furnish personnel who will be exposed to lead-contaminated dust with proper disposable protective whole body clothing, head covering, gloves, and foot coverings as required by 29 CFR 1926.62. Furnish proper disposable plastic or rubber gloves to protect hands. Reduce the level of protection only after obtaining approval from the CP.

1.6.3 Rental Equipment Notification

If rental equipment is to be used during lead-based paint handling and disposal, notify the rental agency in writing concerning the intended use of the equipment. Furnish a copy of the written notification to the Contracting Officer.

1.6.4 Vacuum Filters

UL 586 labeled HEPA filters.

1.6.5 Equipment for Government Personnel

Furnish the Contracting Officer with two complete sets of personal protective equipment (PPE) daily, as required herein, for entry into and inspection of the paint removal work within the lead controlled area. Personal protective equipment shall include disposable whole body covering, including appropriate foot, head, and hand protection. PPE shall remain the property of the Contractor. The Government will provide respiratory protection for the Contracting Officer.

1.7 PROJECT/SITE CONDITIONS

1.7.1 Protection of Adjacent Areas

Perform paint removal work without contamination of adjacent areas.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Protection

3.1.1.1 Notification

a. Notify the Contracting Officer 20 days prior to the start of any paint removal work.

3.1.1.2 Boundary Requirements

a. Provide physical boundaries around the lead control area by roping off the area designated in the work plan or providing curtains, portable partitions or other enclosures to ensure that lead will not escape outside the lead control area.

b. Warning Signs - Provide warning signs at approaches to lead control areas. Locate signs at such a distance that personnel may read the sign and take the necessary precautions before entering the area. Signs shall comply with the requirements of 29 CFR 1926.62.

3.1.1.5 Decontamination Shower Facility

Provide clean and contaminated change rooms and shower facilities in accordance with this specification and 29 CFR 1926.62.

3.1.1.6 Eye Wash Station

Where eyes may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes shall be provided within the work area.

3.1.1.8 Personnel Protection

Personnel shall wear and use protective clothing and equipment as specified herein. Eating, smoking, or drinking or application of cosmetics is not permitted in the lead control area. No one will be permitted in the lead control area unless they have been appropriately trained and provided with protective equipment.

3.3 ERECTION

3.3.1 Lead Control Area Requirements

Establish a lead control area by situating critical barriers and physical boundaries around the area or structure where LBP/PWL removal/control operations will be performed.

3.4 APPLICATION

3.4.1 Work Procedures

Perform removal of lead-based paint in accordance with approved lead-based paint/paint with lead removal/control plan. Use procedures and equipment required to limit occupational and environmental exposure to lead when lead-based paint is removed in accordance with 29 CFR

1926.62. Dispose of removed paint chips and associated waste in compliance with Environmental Protection Agency (EPA), State, and local requirements.

3.4.2 Lead-Based Paint Removal/Control/Deleading

Provide methodology for LBP removal/control in work plan. Remove paint within the areas designated on the drawings in order to completely expose the substrate. Take whatever precautions necessary to minimize damage to the underlying substrate.

Provide methodology for LBP/PWL removal and processes to minimize contamination of work areas outside the control area with lead-contaminated dust or other lead-contaminated debris/waste and to ensure that unprotected personnel are not exposed to hazardous concentrations of lead. Describe this LBP/PWL removal/control process in the LBP/PWL.

3.3.2.2 Outdoor Paint Removal

Perform outdoor removal as indicated in federal, State, and local regulations and in the LBP/CPR/CP. The worksite preparation (barriers or containments) shall be job dependent and presented in the LBP/PWL R/CP.

3.4.3 Personnel Exiting Procedures

Whenever personnel exit the lead-controlled area, they shall perform the following procedures and shall not leave the work place wearing any clothing or equipment worn during the work day:

a. Vacuum themselves off.

b. Remove protective clothing in the contaminated change room, and place them in an approved impermeable disposal bag.

c. Wash hands and face at the site, don appropriate disposable or uncontaminated reusable clothing; move to an appropriate facility; shower.

d. Change to clean clothes prior to leaving the physical boundary designated around the lead control area.

3.5 FIELD QUALITY CONTROL

3.5.1 Tests

3.5.1.1 Air and Wipe Sampling

Air sample for lead in accordance with 29 CFR 1926.62 and as specified herein. Air and wipe sampling shall be directed or performed by the CP.

a. The CP shall be on the job site directing the air and non-clearance wipe sampling and inspecting the lead-based paint removal/control work to ensure that the requirements of the contract have been satisfied during the entire lead-based paint removal operation.

b. Collect personal air samples on employees who are expected to have the greatest risk of exposure as determined by the CP. In addition, collect air samples on at least 25 percent of the work crew or a minimum of two employees, whichever is greater, during each work shift.

c. Submit results of air samples, within 72 hours after the air samples are taken.

d. Before any work begins, collect and analyze baseline wipe and soil samples in accordance with methods defined in federal, State, and local standards inside and outside of the physical boundary to assess the degree of dust contamination in the facility prior to lead-based paint removal/control.

3.5.1.2 Air Sampling During Demolition Work

Conduct area air sampling daily, on each shift in which lead-based paint removal operations are performed, in areas immediately adjacent to the lead control area. Sufficient area monitoring shall be conducted to ensure unprotected personnel are not exposed at or above 30 micrograms per cubic meter of air. If 30 micrograms per cubic meter of air is reached or exceeded, stop work, correct the conditions(s) causing the increased levels. Notify the Contracting Officer immediately. Determine if condition(s) require any further change in work methods. Removal work shall resume only after the CP and the Contracting Officer give approval. For outdoor operations, at least one sample on each shift shall be taken on the downwind side of the lead control area.

3.5.1.3 Sampling After Demolition Removal/Control

After the visual inspection, conduct soil sampling if bare soil is present during external removal/control operations and collect wipe samples according to the HUD protocol contained in HUD 6780 to determine the lead content of settled dust and dirt in micrograms per square meter foot of surface area .

3.6 CLEANING AND DISPOSAL

3.6.1 Cleanup

Maintain surfaces of the lead control area free of accumulations of paint chips and dust. Restrict the spread of dust and debris; keep waste from being distributed over the work area. Do not dry sweep or use compressed air to clean up the area. At the end of each shift and when the paint removal operation has been completed, clean the area of visible lead paint contamination by vacuuming with a HEPA filtered vacuum cleaner, wet mopping the area and wet wiping the area as indicated by the CP. Reclean areas showing dust or residual paint chips or debris. After visible dust, chips and debris is removed, wet wipe and HEPA vacuum all surfaces in the work area. If adjacent areas become contaminated at any time during the work, clean, visually inspect, and then wipe sample all contaminated areas. The CP shall then certify in writing that the area has been cleaned of lead contamination before restarting work.

3.6.1.1 Clearance Certification

The CP shall certify in writing that air samples collected outside the lead control area during paint removal operations are less than 30 micrograms per cubic meter of air; the respiratory protection used for the employees was adequate; the work procedures were performed in accordance with 29 CFR 1926.62 and 40 CFR 745; and that there were no visible accumulations of material and dust containing lead left in the work site. Do not remove the lead control area or roped off boundary and warning signs prior to the Contracting Officer's acknowledgement of receipt of the CP certification.

The third party consultant shall certify surface wipe sample results collected inside and outside the work area are not significantly greater than the initial surface loading determined prior to work.

For exterior paint removal/control work, soil samples taken at the exterior of the work site shall be used to determine if soil lead levels had increased at a statistically significant level (significant at the 95 percent confidence limit) from the soil lead levels prior to the work. If soil lead levels do show a statistically significant increase or is above any applicable Federal or State standard for lead in soil, the soil shall be remediated back to the pre-work level.

3.6.2 Disposal

The contractor shall perform a TCLP analysis of the demolished tank material to verify if the lead exceeds the regulatory levels. It the demolished tank material exceeds the regulatory level them the following requirement shall apply.

a. All material, whether hazardous or non-hazardous shall be disposed in accordance with laws and provisions and Federal, State, or local regulations. Ensure waste is properly

characterized. The result of each waste characterization (TCLP for RCRA materials) will dictate disposal requirements.

3.6.2.1 Disposal Documentation

Submit written evidence to demonstrate the hazardous waste treatment, storage, or disposal facility (TSD) is approved for lead disposal by the EPA, State or local regulatory agencies. Submit one copy of the completed hazardous waste manifest, signed and dated by the initial transporter in accordance with 40 CFR 262. Contractor shall provide a certificate that the waste was accepted by the disposal facility.

END OF SECTION 13283

INDUSTRIAL HYGIENE PROFESSIONALS, INC.

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April 4, 2013

Kenneth M. Rekdahl
Chief of Special Projects
Duenas, Camacho & Associates
671-477-7991
671-649-6315 (fax)

Re: Lead-based Paint (LBP) Testing Results for the Guam Power Authority Dededo Substation, Dededo, Guam

Mr. Rekdahl:

The following is a summary of the Lead-based Paint (LBP) testing conducted on April 2, 2013 for the southern transformers area of the Guam Power Authority (GPA) Dededo Substation, Dededo, Guam. The purpose of the testing was to determine if LBP is present on surfaces affected by the scope of work to be performed by Duenas, Camacho & Associates (DCA).

Measurements were taken using a Bruker MAP 4 X-Ray Fluorescence (XRF) spectrum analyzer (serial number: M41461) set in the "unlimited" mode of precision with a minimum of 95% confidence. Calibration checks were performed prior to testing in accordance with manufacturer instructions. A total of 19 measurements were collected on representative areas of the site. The ranges of test results for each area are summarized in Table 1.

Table 1. LBP Testing Results –GPA Dededo Substation, Dededo, Guam

Sample Area/Description	K-Shell (mg/cm^2)	L-Shell (mg/cm^2)	Result	Photo #
Metal Frame/Structure – Metal – Gray	0.26 through 0.87	n/a	Negative	--
Berm Walls – Concrete – Yellow	-0.24 trough 0.62	0.17 through 0.46	Negative	---
Berm Floor of X-221 – Concrete – Green, Brown	1.24 through 2.00	0.64 through 0.71	Positive	1
All Other Berm Floors – Concrete – Green, Brown, Bare	0.40 through 0.81	0.17 through 0.32	Negative	---

Photo 1 – Berm Floor of X-221 – Concrete – Green, Brown

Federal standards (EPA/HUD) regulate paint containing greater than or equal to one milligram per square centimeter (≥ 1.0 mg/cm^2) or 0.5 percent (≥ 0.5%) lead as LBP. Results reported as "positive" indicate lead concentrations greater than or equal to 1.0 mg/cm^2. Results reported as "negative" indicate lead concentrations less than 1.0 mg/cm^2.

Results indicate that LBP is present on the berm floor of the component labeled "X-221" at the GPA Dededo Substation. LBP was not detected in any of the other tested compnents/surfaces. Please refer to Table 1 and Photo above for reference.

The disturbance of LBP at this facility must be performed in accordance with OSHA lead standards for construction (29 CFR 1926.62) and US EPA hazardous waste regulations (40 CFR Parts 240-282). The OSHA lead standard includes requirements for worker training, medical surveillance, air monitoring, personal protective equipment, and hygiene facilities. In addition, any waste generated from the disturbance of these surfaces may be regulated by the EPA as hazardous waste.

Should you have any questions or concerns please feel free to contact me at the above numbers.

Sincerely,

John M. Fernandez, CIH, CSP, CMC

SECTION 15000

MECHANICAL GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 APPLICATION

This section applies to all sections of Division 11I, Mechanical of this project.

1.2 LAWS, REGULATIONS AND CODES

All work shall be in accordance with government laws, ordinances, rules, regulations, and orders.

The following shall govern where applicable: The Uniform Building Code, The Uniform Plumbing Code, The Uniform Mechanical Code, Applicable National Fire Protection Association Standards, OSHA Rules and Regulations, and all other codes and standards referenced in these specifications. Where requirements differ in these codes and standards, the more stringent shall apply.

1.3 TRADE NAMES

Mentioning of a trade name indicates that the manufacturer is acceptable to the Engineer. However, certain specified construction and details may not be regularly included in the manufacturer's catalogued product. The Mechanical Contractor shall provide the material or equipment complete as specified.

1.4 AVAILABILITY OF EQUIPMENT AND MATERIALS

Specified equipment and materials may not be available locally and must be ordered off-island. This does not give Contractor the option to substitute non-complying materials or equipment that is locally available.

1.5 DEFINITIONS

a. "As directed" shall mean that the Mechanical Contractor shall seek instructions of the Engineer.

b. "As indicated" shall mean as shown on plans.

c. "As necessary" shall mean that the item shall be provided if necessary to have all systems complete, tested, and ready for operation.

d. "Furnish" shall mean that the Mechanical Contractor shall furnish item indicated, installation will be done under another work.

e. "Mechanical Contractor" shall mean the Plumbing Contractor, the Air Conditioning Contractor, or the Fire Protection System Contractor.

f. "Provide" shall mean the Mechanical Contractor shall furnish and install item indicated.

g. "Or approved equal" used after a trade name shall mean that the trade name mentioned will be used as a basis of comparison and that all makes of similar item will be considered, provided that, in the opinion of the Engineer, substituted item has equal or better quality than the trade name mentioned.

h. "Or approved equivalent as manufactured by" shall mean that only products of manufacturers mentioned in the paragraph are acceptable to the Engineer.

1.6 SUBMITTALS

Submit six sets of shop drawings, manufacturer's data and certificates for equipment, materials and finish, and pertinent details for each system where specified in each individual section, and have them approved before procurement, fabrication, or delivery of the items to the job site. Partial submittals will not be acceptable and will be returned without review. Submittals shall include the manufacturer's name, trade name, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and paragraph reference, applicable industry, and technical society publication references, and other information necessary to establish contract compliance of each item the Contractor proposes to furnish.

a. Shop Drawings: Drawings shall be a minimum of 8.5 inches by 11 inches in size, except as specified otherwise. Drawings shall include floor plans, sectional views, wiring diagrams, and installation details of equipment; and equipment spaces identifying and indicating proposed location, layout and arrangement of items of equipment, control panels, accessories, piping, ductwork, and other items that must be shown to assure a coordinated installation. Wiring diagrams shall identify circuit terminals, and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement, drawings shall be revised to show acceptable equipment and be resubmitted.

b. Manufacturer's Data: Submittals for each manufactured item shall be manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts.

c. Standards Compliance: When materials or equipment must conform to the standards of

organizations such as the American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), and Underwriters Laboratories (UL), proof of such conformance shall be submitted to the Engineer for approval. If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified in the individual sections.

d. Certificates of Conformance or Compliance: Submit certification from the manufacturer attesting that materials and equipment to be furnished for this project comply with the requirements of this specification and of the reference publications. Pre-printed certification will not be acceptable; certifications shall be in the original. The certification shall not contain statements that could be interpreted to imply that the product does not meet all requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; "equal or exceed the service and performance of the specified material". The certification shall simply state that the product conforms to the requirements specified.

1.7 OPERATION AND MAINTENANCE MANUAL

For each equipment, furnish an operation and maintenance manual. Furnish three copies of the manual bound in hardback binders or an approved equivalent. Furnish one complete manual prior to the time that equipment tests are performed, and furnish the remaining manuals before the contract is completed. Inscribe the following identification on the cover: the words OPERATION AND MAINTENANCE MANUAL, the name and location of the equipment or the building and the name of the Contractor. The manual shall include the names, addresses, and telephone numbers of each subcontractor installing equipment, and of the local representatives for each item of equipment. The manual shall have a table of contents and be assembled to conform to the table of contents with the tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in. The manual shall include: wiring and control diagrams with data to explain detailed operation and control of each item of equipment; a control sequence describing start-up, operation and shut-down; description of the function of each principal item of equipment; the procedure for starting; the procedure for operation; shut-down instructions; installation instructions; maintenance instructions; lubrication schedule including type, grade, temperature range, and frequency; safety precautions, diagrams, and illustrations; test procedures; performance data; and parts list. The parts lists for equipment shall indicate the sources of supply, recommended spare parts, and the service organization which is reasonably convenient to the project site. The manual shall be complete in all respects for equipment, controls, accessories, and associated appurtenances provided.

1.8 DELIVERY AND STORAGE

Equipment and materials shall be carefully handled, properly stored, and adequately protected to

prevent damage before and during installation. Damaged or defective items shall be replaced.

1.9 CATALOGED PRODUCTS

Materials and equipment shall be cataloged products of manufacturers regularly engaged in production of such materials or equipment and shall be manufacturer's latest design that complies with the specification requirements. Materials and equipment shall duplicate items that have been in satisfactory commercial or industrial use at least two years prior to bid opening. Where two 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 items need not be the products of the same manufacturer. Each item of equipment shall have the manufacturer's name, address, model number, and serial number on the nameplate securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.10 SAFETY REQUIREMENTS

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys and other rotating parts located so that any person can come in close proximity thereto shall be fully enclosed or properly guarded. High-temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be properly guarded or covered with insulation of a type as specified herein.

1.11 MANUFACTURER'S RECOMMENDATIONS

Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Engineer prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

1.12 WORK INCLUDED IN OTHER SECTIONS

The following are included in the General Contract Work and all pertinent information required shall be provided by the Mechanical Contractor.

a. Concrete Pads or Runners For Equipment: Pads and runners shall be at least 6" above the floor, roof, or grade level and pads shall clear equipment base by at least 4" all around unless indicated otherwise.

b. Door Louvers and Undercutting of Doors: Door louvers and undercutting of doors are under the General Contractors work.

c. Screened Louvers: Screened louvers on exterior walls shall be furnished by the Mechanical

Contractor for installation by the General Contractor.

d. Utilities: Cold water service line building sewer and storm sewer main will be provided up to within 5 feet of the building line or as indicated. Final connection to these utilities shall be done by the Mechanical Contractor.

The following are included under Electrical Work

a. Power Wiring: All power wiring, including final hook-up to all mechanical equipment will be provided under the Electrical Work. Where control devices are required on power wiring such as a high temperature limit control for an exhaust fan, the control devices shall be installed by the Mechanical Contractor but shall be wired by the Electrical Contractor.

b. Division 11I, ELECTRICAL, is based on electrical ratings of equipment indicated on the mechanical drawings. Any deviation by the Mechanical Work which requires a change in the Electrical Work shall be paid for by the Mechanical Contractor.

c. Starters: The Mechanical Contractor shall furnish all starters and motor control centers where specified, for installation by the Electrical Contractor. The Mechanical Contractor shall turn over these items to the Electrical Contractor at site after receipt of notice from the Electrical Contractor that he is ready to install starters and motor control centers.

1.13 WORK TO BE DONE IN ACCORDANCE WITH OTHER SECTIONS

All electrical work and control wiring, included under Mechanical Work, shall be in accordance with Division 11I, ELECTRICAL.

1.14 AS-BUILT DRAWINGS

The Contractor shall maintain at the site one copy of all Drawings, Specifications, Addenda, approved Shop Drawings, Change Orders, and other modifications, in good order and marked to record all changes made during construction. These shall be made available to the Engineer.
At the conclusion of the work, the Mechanical Contractor will be furnished by the Architect, at the Mechanical Contractor's expense, a set of reproducible made from original contract plans. The Mechanical Contractor shall then incorporate all changes made, as recorded, the set of reproducible in a clear, legible and reproducible manner. As a condition for acceptance of work, "as-built" reproducible shall be signed by Mechanical Contractor attesting that all changes have been incorporated, dated and delivered to the Engineer.

As-built drawings required for

SECTION 15400 - INTERIOR PLUMBING SYSTEM

SECTION 15500 - AIR CONDITIONING AND VENTILATION SYSTEMS

END OF SECTION 15000

SECTION 15400

INTERIOR PLUMBING SYSTEM

PART 1 GENERAL

1.1 SCOPE OF WORK

a. Work included: The plumbing system for this Work includes cold water distribution system, waste and vent system, and shower/eyewash piping, and all other plumbing items indicated on the Drawings or described in these Specifications, plus all other plumbing items needed for a complete and proper installations.

b. Related work described elsewhere

(1) Perform all trenching and backfilling associated with the plumbing installation in strict accordance with the provisions of "Earthwork" Section.

(2) Utilities: Cold water service line and building storm drain will be provided up to within 5 feet of the building line or as indicated. Final connection to these utilities shall be done by the Mechanical Contractor.

1.2 QUALITY ASSURANCE

Use sufficient journeyman plumbers and competent supervisors in execution of this portion of the Work to ensure proper and adequate installation throughout. In the acceptance or rejection of installed plumbing, no allowance will be made for lack of skill on the part of workmen.

1.3 SUBMITTALS

a. General: Comply with the provisions of Section 15000.

b. Product data: Within 35 calendar days after award of Contract, submit:

(1) Catalog cuts and other data required to demonstrate compliance with the specified requirements shall be provided for the following:

(a) Shower/Eyewash
(b) Drains
(c) Cleanouts
(d) Hose Bibb

(e) Valves

c. Operation and Maintenance Manual: Upon completion of this portion of the Work, and as a condition of its acceptance, compile and submit manuals as required under Section 15000 of these Specifications.

1.4 PRODUCT HANDLING

a. Protection: Use all means necessary to protect the materials of this Section before, during, and after installation and to protect the work and materials of all other trades.

b. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer and at no additional cost to the Owner.

PART 2 PRODUCTS

2.1 PIPE

a. Waste & Storm Drain Piping: Piping shall be cast iron pipes and fittings with stainless steel clamp and shield assemblies cast iron piping shall conform to ASTM A74.

b. Domestic Water Piping

(1) All domestic hot and cold water piping shall be hard-drawn copper tube conforming to ASTM B88 with wrought copper fittings.

(2) Below-grade and below-slab copper piping shall be type "K" with brazed joints; all other copper piping shall be type "L" with joints made up of 95-5 tin-antimony solder.

2.2 PIPE WRAPPING

Wrap all water pipe buried in the ground, with "Scotchrap". Wrap all straight runs with 0.020-inch thick tape, spirally applied in half-lap layers. Pre-wrap all joints, valves, and similar irregular surfaces using 0.010-inch thick tape.

2.3 VALVES

Gate valves shall be bronze, solid wedge, inside screw, traveling stem, screw-in-bonnet, 200 lbs. W.O.G., solder ends, "Jenkins" Figure 1242 or approved equal.

2.4 PIPE SLEEVES AND ESCUTCHEONS

All pipe sleeves and escutcheons shall be steel pipe and shall have ample clearance for pipe and covering, and shall have chrome plated wall and floor escutcheons over the pipe in finished areas.

2.5 HANGERS AND SUPPORTS

a. Hangers and supports shall equal or exceed the quality of the following:

	Item	Manufacturer and Number
1.	Pipe ring hanger	Grinnel Fig. 97cp, copper plated, for copper pipes, plastic coated for plastic pipes
2.	Clevis Type Hanger	Grinnel Fig. 260, galvanized, for cast iron or steel pipe

b. Hanger rods shall be galvanized and shall conform to the following:

	Pipe Size	Rod Diameter
1.	1/2 inch to 2 inch	3/8 inch
2.	2-1/2 inch to 3-1/2 inch	1/2 inch
3.	4 inch to 5 inch	5/8 inch

2.6 CLEANOUTS

a. General: Provide cleanouts equaling or exceeding the quality of the following:

1.	Floor cleanouts	J. R. Smith number 4023.

2.7 DRAINS

The following are products of "J.R. Smith". Equivalent items as manufactured by "Josam", "Wade" or "Zurn" are acceptable:

a. Floor drains shall be Figure 2010-A, with 5 inch diameter strainer, cast iron body, flashing collar, nickel bronze adjustable strainer head, and caulked outlet.

b. Scupper drains shall be Fig. No. 1530 with galvanized cast iron body, secured grate and flashing device, threaded outlet.

2.8 EMERGENCY SHOWER/ EYEWASH

Floor-mounted self-cleaning, nonclogging 8 inch diameter copper alloy deluge shower head with elbow, 1 inch full-flow valve with full chain and 8 inch diameter ring, 1 inch interconnecting fittings. Mount shower head 7 feet above floor and 2 feet from wall. Self-cleaning, nonclogging eye and face wash with quick opening, full-flow valves, stainless steel eye and face wash receptor. Unit shall deliver 10 gpm of aerated water at 15 psig flow pressure. Mount eye and face wash receptor 38 inches above finished floor. Provide copper alloy control valves.

PART 3 EXECUTION

3.1 INSPECTION

a. Examine the areas and conditions under which work of this Section will be installed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

b. Install all piping promptly, capping or plugging all open ends.

c. Install all piping generally level and plumb, free from traps, and in a manner to conserve for other work.

d. Cushion all traps and bearings to minimize transfer of sound. Provide complete isolation of all dissimilar metals. Firmly anchor all pipes into position.

e. Provide uniform pitch of at least 1/4 inch per foot for horizontal waste piping within the building.

f. Pitch all vents for proper drainage. Install vent piping with each bend 45 degrees minimum from the horizontal wherever structural conditions will permit.

g. Conceal all piping unless otherwise shown on the Drawings.

h. Inspect each piece of pipe, couplings, fittings, and equipment for defects and obstructions. Promptly remove all defective material from the site.

3.2 JOINTS AND CONNECTIONS

a. Preparation: Properly ream all cut pipes. Cut all threads straight and true, apply best quality Teflon tape to male pipe threads, but not to inside the fittings. Use graphite on all cleanout plugs.

3.3 HANGERS AND SUPPORTS

a. Spacing: Do not exceed five feet on centers spacing.

b. Supporting: Use a separate hanger for each branch. Support vertical risers at the floor with extension pipe clamps approved by the Engineer.

c. Secure all branch take-off to fixture immediately before fixture faucet inlet connections, conceal support or clamp in wall.

3.4 CLOSING IN UNINSPECTED WORK

Do not cover up or enclose work until it has been properly and completely inspected and approved. Should any of the work be covered up or enclosed prior to all required inspections and approvals, uncover the work as required and, after it has been completely inspected and approved, make all repairs and replacements with such materials and workmanship as are necessary to the approval of the Engineer, and at no additional cost to the Owner.

3.5 TESTING

a. General: Furnish all test pumps, gages, equipment, and personnel required, and test as necessary to demonstrate the integrity of the finished installation to the approval of all pertinent authorities and the Engineer.

b. Waste, and vent piping: Unless otherwise directed, plug all openings and fill with water to a height not less than 10 feet above horizontal pipes. Allow to stand one hour or longer as required. Re-do leaking joints as directed and then re-test.

c. Water lines: Test and make tight at 150 psi water gage. Retain for four hours; repair all leaking joints and then re-test.

3.6 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

a. Prior to connecting to existing piping, flush clean and disinfect new piping.

b. Ensure PH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

c. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/l residual.

d. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum

15 percent of outlets.

e. Maintain disinfectant in system for 24 hours.

f. If final disinfectant residual tests less than 50 mg/l, repeat treatment.

g. Flush disinfectant from system until residual disinfectant equals that of incoming water or not more than 0.5 mg/l nor less than 0.2 mg/l.

h. Takes samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C601.

i. Bacteriological Analysis of Water: After the completion of disinfection procedure, including the final flushing as described heretofore, the Contractor shall obtain water samples from this system for bacteriological analysis. Requirements for satisfactory disinfection of water supply are that bacteriological analysis indicates that water samples are negative for coliform organisms and that total plate count is less than 100 bacteria per cubic centimeter. Submit certified laboratory analysis to Guam EPA for evaluation.

j. Final Approval: If bacteriological analysis does not satisfy above requirements, then disinfection procedure shall be repeated until these requirements are met.

k. Discharging Used Water: Water used in the disinfection process must be disposed of to a ponding basin, percolation trench, holding tank, water truck tank or to any other location and method acceptable to Guam EPA.

l. Certification: Deliver a "Certificate of Completion of Disinfection" to the Engineer.

3.7 LEAD ANALYSIS

Lead concentration of water in the new water line must be analyzed and submit test results to Guam Environmental Protection Agency (GEPA).

END OF SECTION 15400

SECTION 15500

AIR CONDITIONING AND VENTILATION SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF WORK

a. Work Included: Air conditioning and ventilation required for this Work is indicated on the Drawings and includes, but is not necessarily limited to:

(1) Air conditioning and ventilation equipment.

(2) Ductwork and accessories.

(3) Diffusers, Grilles, and Registers.

(4) Refrigerant Piping and Accessories.

(5) Condensate Drain Piping.

(6) Insulation.

(7) Controls.

(8) All other items required for a complete and operating air conditioning and ventilation systems.

b. Related Work Described Elsewhere: Interior Wiring Systems, Section 16402.

1.2 QUALITY ASSURANCE

a. Qualifications of Installers

(1) For the actual fabrication, installation, and testing of work under this Section, uses only thoroughly trained and experienced workmen completely familiar with the items required and the manufacturer's current recommended methods of installation.

(2) In acceptance or rejection of installed work, the Architect will make no allowance for lack of skill on the part of workmen.

b. Codes and Standards: In addition to complying with all pertinent codes and regulations,comply with all pertinent recommendations contained in the Standards listed

below, latest edition, as published by the Sheet Metal and Air Conditioning Contractor's National Association.

(1) HVAC Metal Duct Standards.

(2) Fiberglass Duct Construction Standard.

(3) Duct Liner Application Standard.

(4) HVAC Systems Testing, Adjusting, and Balancing.

1.3 SUBMITTALS

a. General: Comply with the provisions of Section 15000.

b. Product Data: Within 35 calendar days after award of the Contract, submit:

(1) Following items proposed to be furnished and installed under this section.

(a) All air conditioning and ventilating equipment

(b) Variable air volume box.

(c) Diffusers, Grilles and Registers

(d) Insulation

(2) Shop Drawing showing all details of the proposed installation, and the interface of ducts, piping and equipment with all other items.

(3) Manufacturer's recommended installation procedures which, when approved by the Architect, will become the basis for inspecting and accepting or rejecting actual installation procedures used on the Work.

c. Record Documents: During progress of the Work, maintain an accurate record of all changes made in the air conditioning and ventilating systems from the layout and materials shown on the approved submittals.

d. Manual: Upon completion of this portion of the Work, and as a condition of its acceptance, deliver to the Owner and the Architect each three copies of the operations and maintenance Manual. Include in each copy of the Manual a copy of the Record Documents.

e. Control Wiring Diagrams: Submit for approval along with shop drawings.

1.4 PRODUCTS HANDLING

a. Protection: Use all means necessary to protect the materials of this Section before, during, and after installation and to protect the work and materials of all other trades.

b. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 EQUIPMENT

a. General: All equipment shall be the capacity and types shown on the Equipment Schedule in the Drawings, and shall be the listed manufacturer and model number or shall be an equal approved in advance by the Architect. Use only air conditioning equipment that has local representatives.

b. Single Source: For ease of maintenance and parts replacement, to the maximum extent possible use equipment of a single manufacturer.

c. The Architect reserves the right to reject any materials list which contains equipment from various manufacturers if suitable materials can be secured from fewer manufacturers, and to require source of materials to be unified to the maximum extent possible.

d. Condensing Unit:

(1) Condensing unit shall be UL listed, air-cooled consisting of compressor, condenser, condenser fan and motor, interconnecting refrigerant piping with service valves, safety devices and controls, all factory assembled in weatherproof casing.

(2) Compressor shall be hermetic with vibration isolators. Condenser coils shall be of copper tubes with aluminum fins mechanically bonded to the copper tubes and factory applied phenolic coating. Condenser fans shall be directly driven by condenser fan motors and arranged for vertical upblast discharge. Fan motor shall be factory lubricated, inherently protected, and resiliently mounted.

(3) Controls shall be factory wired and located in a readily accessible location. Controls shall include compressor overload devices, starters, relays, short cycling protection and other devices standard to the manufacturers. Factory wiring shall be complete such that only one power supply will be required at the field for each condensing unit.

(4) Safety devices shall include temperature and current sensitive overload and high and low pressure switches.

(5) Casing shall be fully weatherproof, constructed of galvanized steel finished with baked enamel.

(6) Refrigerant circuit shall include liquid and suction line service valves and filter-drier.

(7) Refrigerant shall be R 410-A.

(8) Air-cooled condensing units shall be "Carrier" 38AUZ Series or approved equal as manufactured by “Lennox”, "Trane" or "York.

(9) Accessories shall include a space mounted thermostat with on-off-auto switch.

(10) Condensing unit shall be provided with a 3-phase power monitor to protect the unit from damage due to power supply-irregularities. The 3-phase power monitor shall turn off the unit whenever any or all of the following conditions occur:

(a) Low voltage on any or all phases.

(b) Loss of any phase.

(c) Unbalanced voltage between phases.

(d) Phase being reversed from A-B-C sequence.

3-phase monitor shall have automatic reset, to be mounted adjacent to electrical panels for condensing unit.

e. Air Handling Units

(1) Air handling units shall be manufactured in a facility registered to ISO 9002 manufacturing quality standard, factory tested, with performances based on tests conducted in accordance with AMMCA Standard 210 and ARI Standard 430 and meet NFPA 90A requirements.

(2) Coils shall meet the scheduled performance. Coil performance shall be certified in accordance with ARI 410. Shall be designed and tested in accordance with ASHRAE/ANSI 15 Safety Code for Mechanical. Refrigerant coils shall have minimum ½ inch OD copper tubes mechanically expanded into fins to ensure high thermal performance with lower total flow and pumping requirements. Minimum tube wall thickness shall be 0.25 inches.

(3) Evaporator fan shall have one double width double inlet (DWDI) fan wheel and scroll. Fan shall be constructed of galvanized steel with baked enamel. They shall be designed for continuous operation at the maximum rated fan speed and motor horsepower. Fans shall have an AMCA class rating corresponding to the static pressure at which the fan is designed to operate (Class 1 or II). Completed fan assembly shall be dynamically balanced in accordance with 1989 ARI Guideline G and ANSI S2.19-1986 at design operating speed using contract drive and motor.

(4) Casing panels shall be constructed of galvanized steel with pre-painted, baked enamel finish passing 500-hour salt spray test (ASTM B-117) for pre-painted steel and 125-hour marine level 1 prohesion test (ASTM-85.A5) pre painted steel inside and out. Interior panels shall be coated with silver zeolite antimicrobial material registered by US EPA for use in HVAC.

(5) Filters shall be standard size and not less than 2 inches thick. Low velocity throwaway filters shall be used and shall be protected from the cooling coil condensate.

(6) Drain pans shall be insulated double wall stainless steel construction. The pan shall be sloped in 4 directions toward the drain fitting. Drain pan shall have a recessed bottom drain design with integral FPT elbow for side discharge and trapping. One drain outlet shall be supplied for each cooling coil section. Drain pan shall allow no standing water and comply with ASHRAE Standard 62. Where 2 or more coils are stacked in a coil bank, intermediate drain pans shall be provided and the condensate shall be piped to the bottom drain pan. The bottom coil shall not serve as a drain path for the upper coil.

(7) Accessories shall include thermostats with a/c switches and indoor fan relays.

(8) Unit shall have factory-installed variable frequency drive and static pressure sensors for static pressure control.

(9) Fan motor shall be mounted within the fan section casing on slide rails equipped with adjusting screws. Motor shall be high efficiency totally enclosed fan cooled NEMA Design B with size and electrical characteristics as shown on the equipment schedule. Motor shall be mounted on a horizontal flat surface and shall not be supported by the fan or its structural members. Motors shall have a $\pm$ 10% voltage utilization range and a 1.15 minimum service factor. Motors shall be compliant with EPACT.

(10) Motor starter shall be NEMA Design B. Starter may be of the full voltage type provided that the motor starting current do not exceed values allowed by the local

power company or other regulating agencies. Otherwise, starters shall be of the reduced current inrush star-delta type. All starters shall have bimetallic type overcurrent protective relays on each leg, 120-volt control circuits with integral transformers, auxiliary contract as required. Starter enclosures shall be NEMA 1.

(11) Units shall be “Carrier” 39M Series or approved equal as manufactured by “Trane”, “Lennox” or “York”.

f. Wall Ventilator

(1) Centrifugal type with internal parts protected by a heavy gage spun aluminum housing. Drive shall be isolated from the air stream. Wheel shall be statically and dynamically balanced, all aluminum. Provide unit complete with backdraft damper, bird screen, and disconnect switch. Capacity shall be as indicated.

(2) Wall ventilator shall be product of Greenheck or approved equal.

2.2 REFRIGERANT PIPING AND ACCESSORIES

a. Refrigerant piping shall be hard-drawn copper, Type "K" or "L" conforming to ASTM B88 with wrought copper fittings, brazed joints.

b. Flexible Pipe Connections for refrigerant piping shall be seamless bronze corrugated hose with bronze braiding and sweat fittings tube ends suitable for system pressure where connection is installed.

c. Piping Accessories: Filter drier and indicator sight glass shall be products of "Alco", "Henry", or "Mueller".

2.3 CONDENSATE DRAIN PIPING

Condensate drain piping shall be polyvinyl chloride DWV pipes and fittings conforming to ASTM D2665 with solvent weld joints inside the building, schedule 40 galvanized steel pipes conforming to ASTM A53 or A120 with screwed cast iron drainage fittings when exposed outdoors.

2.4 DUCTWORK

Air conditioning and ventilation ducts shall be fabricated from prime grade galvanized steel sheets.

2.5 DUCTWORK ACCESSORIES

a. Volume dampers shall be factory fabricated of galvanized steel, at least 2 gauges heavier than duct where dampers are installed, single-bladed for duct depths up to 10", opposed

blade type for ducts with depths more than 10" complete with indicating locking quadrants. Volume dampers for installation above plaster ceilings shall have remote damper operators mounted on plaster ceilings.

b. Turning vanes shall be factory fabricated of galvanized steel, with double-walled blades rolled from a single sheet of metal, assembled over precision-formed tenons on the side pieces. Turning vanes shall be screwed or riveted into the duct elbow.

2.6 VARIABLE AIR VOLUME BOXES

a. Variable Air Volume (VAV) Boxes shall be factory-assembled, externally powered, variable air volume control terminal. Unit shall be complete with a damper assembly, flow sensor, externally mounted volume controller, collars for duct connection and all required features. Control box shall be clearly marked with an identification label that lists such information as nominal cfm, maximum and minimum factory-set airflow limits.

b. Unit cabinet shall be constructed of 22-gage galvanized steel with round inlet and discharge collar. All primary air inlet and discharge collars shall accommodate standard flex duct sizes.

c. The control air damper assembly shall be constructed of heavy-gage steel with solid shaft rotating in Delrin® bearings. Damper shaft shall be marked on the end to indicate damper position. Damper blade shall incorporate a flexible gasket for tight airflow shutoff and operate over a full 90 degrees.

d. Units shall have communicating controls, capable of maintaining required airflow set points $\pm$ 5% of the unit's capacity at any inlet pressure up to 6-in. wg. The controllers shall be capable of resetting between factory or field-set maximum and minimum (>350 fpm inlet duct velocity) set points to satisfy the room thermostat demand.

The unit shall be equipped with an amplified linear averaging flow probe located at 45 degrees across the inlet. The sensor will provide a differential pressure signal amplified to equal 3 times the velocity pressure with an accuracy of at least $\pm$ 10% throughout the range of 350 to 2500 fpm inlet duct velocity, depending on the controller employed.

e. Variable Air Volume Boxes shall be "Carrier" 35K Series or approved equal.

2.7 AIR INLETS AND OUTLETS

a. The following items are products of "Tuttle and Bailey" (Hart & Cooley), similar and equal units as manufactured by "Carnes", "J and J", or "Waterloo" are acceptable. All air outlets shall be factory-finish painted to match adjacent surface color. Contractor shall submit manufacturers color chart for color selection by the Architect.

(1) Supply air registers shall be Series A-647 extruded aluminum registers with removable core, double deflection, vertical outer bars, A45 frame, opposed-blade dampers, and type VLR vectrol air extractors.

(2) Return, outside air and exhaust registers shall be Series A110 aluminum registers with A45 frame, 1-1/4" margin, horizontal bars set at 40 degrees, and opposed blade volume dampers.

(3) Return and transfer grilles shall be as specified for return registers except without volume dampers.

2.8 OUTSIDE AIR INTAKE LOUVERS

a. Outside air intake louvers shall be all aluminum with PVC coated galvanized wire screen, 1/2" screen mesh.

b. Blades shall be "S" shaped, spaced at 2", installed at 20^{o}.

c. Duct collars shall be provided for outside air duct connection.

d. Outside air intake louvers shall be "Carnes" Model L-40 or approved equal.

2.9 INSULATION, ADHESIVES, TAPES, SEALERS

a. All insulation, adhesives, tapes and sealers shall have a flame spread rating of not more than 25 and a smoke developed rating of not more than 50 when tested in accordance with ASTM E84.

b. External Air Conditioning Duct Insulation shall be 1-1/2" thick faced fiberglass duct wrap, Type FRK25, Series ED-100 as manufactured by "Owens-Corning" or approved equal as manufactured by "Johns-Manville" or "Certain Teed".

c. Refrigerant suction line insulation shall be 1-1/2" thick foamglass insulation, product of "Pittsburgh-Corning" or approved equal, with Pittwrap jacketing. All insulation outdoors shall have additional stainless steel jacketing.

d. Condensate drain insulation shall be as specified for refrigerant suction line insulation but 1" thick.

e. Adhesives, sealers and tapes, for use in the application of insulation shall be as recommended by the insulation manufacturer, products of "Minnesota Mining and Manufacturing Co.", "Benjamin Foster", or "United Sheet Metal Company".

2.10 OPERATING AND TEMPERATURE CONTROLS

a. Air Handling Unit

(1) Provide push-button switches to start-stop each air handling unit. Push-button switches can be integral to air handling unit starters if starters are installed inside AHU room.

b. Room Temperature Control

(1) At area served by variable air volume control box, supply air will be modulated by the control boxes to maintain designed room temperature of 75 ± 2^{o} F. A space thermostat shall be provided for the variable air volume box.

c. Fire Alarm Interface

(1) The air conditioning systems shall turn off when the building fire alarm system is energized. Normally closed contacts will be provided for the air conditioning system at the fire alarm control cabinet to be provided under the electrical work. Mechanical Contractor shall provide wiring and conduits from the air conditioning control system to the fire control cabinet; refer to electrical drawings for location of fire control cabinet.

(2) Smoke Detectors shall be provided on all supply and return ducts. Smoke detectors shall open a normally closed electrical contact when products of combustion are detected. Smoke detectors will be wired to the building fire alarm system by the Electrical Contractor.

2.11 OTHER MATERIALS

All other materials not specifically described but required for a complete and proper installation, shall be as selected by the Contractor subject to the approval of the Architect.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

a. Inspection

(1) Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

(2) Verify that the work of this Section may be completed in strict accordance with all pertinent codes and regulations, the approved Shop Drawings, and the manufacturers' recommendations.

a. Discrepancies

(1) In the event of discrepancy, immediately notify the Architect.

(2) Do not proceed in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 INSTALLATION OF EQUIPMENT

a. Locations: Install all equipment in the locations shown on the approved Shop Drawings, except where specifically otherwise approved on the job by the Architect.

b. Install in accordance with manufacturer's published instructions.

c. Secure to concrete runners with properly sized stainless steel anchor bolts. Number of anchor bolts shall at least equal the number of anchor holes provided with the packaged cooling units.

d. Interferences: Avoid interference with structure, and with work of other trades, preserving adequate headroom and clearing all doors and passageways to the approval of the Architect.

e. Inspection: Check each piece of equipment in the system for defects, verifying that all parts are properly furnished and installed, that all items function properly, and that all adjustments have been made.

3.3 PIPING SYSTEMS

a. Piping shall be installed straight and plumb, parallel to building walls and columns, with due allowance for expansion and contraction.

b. Risers shall be provided with hangers at the horizontal line, within 6" of the riser.

c. Refrigerant Piping:

(1) Verify minimum unloaded capacity of compressors and ensure that minimum velocity up hot gas and suction risers will entrain oil for proper oil return to compressor without exceeding maximum pressure drop recommended in the ASHRAE Handbook. If necessary, provide double hot gas or double suction risers.

(2) Pipe sizes shown are for equipment models used in the design. Verify requirements of actual equipment to be used.

d. All drain piping shall be pitched, preferably at 1/4" per foot, 1/8" per foot minimum in the direction of flow, adequate cleanouts shall be provided in changes of direction to facilitate rodding.

3.4 DUCTWORK

a. Provide bracing for all ducts in accordance with SMACNA Seismic Restraint Manual.

b. All medium pressure air conditioning ducts and make-up air ducts shall be fabricated and erected in accordance with the SMACNA High Pressure Duct Construction Standards. All joint shall be sealed air tight by soldering all joints or by use of duct sealers. Rectangular duct reinforcement shall be in accordance with the table for 3" W.G. static pressure. The following ducts are medium pressure duct:

(1) All supply ducts from air handling units to variable air volume air terminals.

c. Low pressure galvanized steel air conditioning ducts shall be fabricated and erected in accordance with the SMACNA HVAC Metal Duct Standards. Beading and crossbreaking are both acceptable. Longitudinal seams shall either be the Pittsburgh lock or Acme locked grooved seam. Button punch snap lock may be used with 1/2" pocket depth for gauge 26 material, 1/2" or 5/8" for gauge 24 and 5/8" for heavier material. Round elbows with standard elbows may be used in lieu of rectangular vaned elbow.

d. All square elbows in all ductwork shall be provided with double thickness turning vanes. All branch take-offs shall be provided with adjustable air extractors.

e. All inlet and outlet connections to equipment shall be provided with neoprene-coated flexible duct connections.

f. Duct dimensions shown are net inside dimensions.

g. Leakage Test - High Pressure Ducts

(1) Testing apparatus shall include a portable rotary blower, an orifice assembly with straightening vanes and orifice plate mounted in a straight tube with properly located pressure taps, and U-tube manometers.

(2) Test for audible leaks as follows

(a) Close off and seal all openings in the duct section to be tested. Connect the

test apparatus to the duct by means of section of flexible duct.

(b) Start the blower with its control damper closed (some small blowers popularly used for testing ducts may damage the duct because they can develop pressures up to 25 inches. W.G.).

(c) Gradually open the inlet damper until the duct pressure reaches 2-inches W.G. in excess of design duct operating pressure. Determine test pressure by using a U-tube manometer. Note that the pressure is indicated by the difference in level between the two legs of the manometer and not by the distance from zero to the reading on one leg only.

(d) Survey all joints for audible leaks. Mark each leak and repair after shutting down blower. Do not apply a retest until sealants have set.

(3) After all audible leaks have been sealed; the remaining leakage should be measured with the orifice section of the test apparatus as follows

(a) Start blower and open dampers until pressure in duct reaches 25% in excess of designed duct operating pressure.

(b) Read the pressure differential across the orifice using the manometer. The leakage rate in cfm is read directly from the calibration curve of the orifice plate. If there is no leakage, the pressure differential will be zero.

(c) If all audible leaks have been corrected, it is unlikely that the measured leakage will exceed one (1) percent of capacity. If it does, the leaks must be located by more careful listening or by feeling along the joint.

(d) It should be noted that even though a system may pass the measured leakage test, a concentration of leakage a one point may result in a noisy leak which, of course, must be corrected.

3.5 INSULATION

a. All air conditioning ducts shall be provided with external duct insulation applied per insulation Manufacturer's Published Instructions.

b. Refrigerant Suction Lines, , Condensate Lines, and lines connected to. Piping shall not be insulated at joints until tested, approved, and painted. Self-sealing adhesive strips shall be pressed in place only with nylon tools to be provided for that specific purpose.

3.6 INSTALLATION OF REGISTERS AND DIFFUSERS

Install and connect all registers and diffusers, in the locations shown on the approved Shop Drawings, securely anchoring each item in place and sealing with rubber gaskets to prevent leakage.

3.7 INSTALLATION OF AIR TERMINALS

Install air terminals in accordance with manufacturer's published installation instruction.

3.8 EQUIPMENT IDENTIFICATION

Equipment labels: All equipment furnished and installed under this Section shall be provided with the manufacturer's metal identification labels securely attached to each individual piece of equipment, and showing complete and comprehensive performance characteristics, size, model number, and serial number.

3.9 AIR SIDE BALANCING AND TESTING REQUIREMENTS

a. Variable Air Volume Systems

(1) Check and note the following items on the supply fan

(a) Proper fan rotation.

(b) Filter condition (must be clean).

(c) Cooling coil condition (dry or wet).

(2) Obtain the following preliminary data at the supply fan

(a) Fan RPM.

(b) Motor current and voltage.

(c) Fan, coil and filter statics.

(d) Nameplate data on the fan and motor.

(e) Check and set the fan belt tension.

(3) Measure the static pressure at the end of each major branch.

(4) Adjust the supply fan RPM to achieve the minimum static pressure required at the

end of each branch to provide required CFM. Monitor the branch static pressure and verify that they are above the minimum required in preceding steps.

(5) Starting at the variable volume terminal closets to the fan, set the thermostat to full cooling.

(6) Make a preliminary measurement of the terminal CFM delivery and proportionally balance the outlets. (Terminals CFM must be preset at the factory).

(7) Set the thermostat to its normal set point. Repeat step 6 through 8 for all variable volume controllers working away from the fan. Set thermostats to full cooling to allow the supply fan to operate at maximum capacity.

(8) Measure the static pressure at the end of each major branch. Adjust the supply RPM to achieve the minimum static pressure required at the end of each branch.

(9) Traverse the main supply duct.

(10) Set all controls to their normal set points.

3.10 TEST REPORTS

a. Completed test report forms and data sheets be submitted in triplicate after testing and balancing is completed. Report form and data sheets shall be as follows:

(1) Air Outlet Test Report - Similar to the following:

OUTLET TEST REPORT

Project Sheet of
System Zone #
Job # Date

Outlet Number	Location Type	Outlet Size	Outlet FPM	Outlet CFM	Factor Req. FPM	Factor Req. CFM	Field Test 1 FPM	Field Test 1 CFM	Final FPM	Final CFM

(2) Air Handling Unit Test Report - Similar to the following:

AIR HANDLER TEST REPORT

Project Sheet of
System Floor # Zone #
Job # Date

Remarks _____

Item	Specified	Field Test 1	Field Test 2	Field Test 3
Outside air cfm				
Total air cfm				
% outside air				
Discharge duct sq. ft.				
Discharge duct fpm				
Return duct sq. ft.				
Return duct fpm				
Return air cfm				
Manufacturer				
Fan size				
Arrangement				
Fan blade				
Fan sheeve				
Motor sheeve				
No. rows coil				
Filters				
Rpm				
Hp				
Bhp				
Volts				
Phase				
Cycle				
Full-load amps				
No-load amps				
Heaters: rated amps				
Suction sp				
Discharge sp				
Total sp				
Ent. DB temperature				
Ent. WB temperature				
Lvg. DB temperature				

Lvg. WB temperature
Outside air temperature
Gpm circulating H_2O
Pressure drop
Ent. water temperature
Lvg. water temperature

Remarks:

(3) Exhaust Fan Data Sheets - indicating all data on fan nameplate, current characteristics to fan motor, suction and discharge static pressures, total fan cfm, and cfm through each exhaust registers.

(4) All other readings required to be recorded under balancing and test requirements.

3.12 CLOSING-IN OF UNINSPECTED WORK

a. General: Do not allow or cause any of the work of this Section to be covered up or enclosed until it has been inspected, tested, and approved by the Architect and by all other authorities having jurisdiction.

b. Uncovering: Should any of the work of this Section be covered up or enclosed before it has been completely inspected, tested, and approved, do all things necessary to uncover all such work. After the work has been completely inspected, tested, and approved, provide all materials and labor necessary and make all repairs necessary to restore the work to its original and proper condition at no additional cost to the Owner.

3.13 COOPERATION WITH OTHER TRADES

Do all things necessary to cooperate with other trades in order that all systems in the Work may be installed in the best arrangement. Coordinate as required with all other trades to share space in common areas and to provide the maximum of access to each system.

3.14 TESTING

a. General: Provide all necessary personnel, equipment, and services and perform all tests necessary to demonstrate the integrity of the completed installation to the approval of the Architect and all other authorities having jurisdiction. Make all adjustments necessary to balance the completed system in accordance with the data shown on the Drawings.

b. Piping Systems Test: Contractor shall make preliminary tests on piping systems and correct all leaks and faults detected. The system shall then be subjected to final tests which shall be observed by the Engineer. The Contractor shall notify the Engineer of testing schedules 2

days before the final tests.

c. Refrigerant Piping Test and Refrigerant Charging

(1) Pressure test refrigerant piping systems with anhydrous carbon dioxide. Test pressures shall be 150 psig for the system low side and 300 psig for the system high side. With system under pressure, test for leaks using soap and water.

(2) After successful pressure testing, evacuate systems to 2.5 mm Hg. absolute with compressor service valves closed. Break the system vacuum with dry nitrogen, open compressor service valves and re-evacuate to 2.5 mm Hg. absolute. Allow evacuated systems to stand for 12 hours, if no pressure rise occurs, the system may be charged with refrigerant.

d. Architect's Right to Retesting

(1) Should the Contractor refuse or neglect to make any tests necessary to demonstration of the integrity of the completed system, the Architect may retain the services of an outside consultant to make all such tests and their resulting adjustments and balance.

(2) The costs for such test shall be deducted from amounts owing to the Contractor and shall not be borne by the Owner.

e. Air Balancing: Perform in accordance with SMACNA HVAC Systems Testing, Adjusting, and Balancing Manual.

3.15 INSTRUCTING

a. Upon completion of all required testing and balancing, and at a date set by the Architect to coincide with the Owner's acceptance of the completed Work, furnish all necessary personnel and thoroughly indoctrinate and instruct the Owner's maintenance and operation personnel in all aspects of operation and maintenance of the installed systems. Demonstrate the contents of the Operation and Maintenance Manual and ensure that the Owner's personnel are thoroughly familiar with all aspects of operation and maintenance of the installed systems.

END OF SECTION 15500

SECTION 16050

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

This Section supplements all sections of Division 11K and 11L, and shall apply to all phases of work specified, shown on the drawings, and required to provide all electrical systems complete and operable for the project. The work required under the Division is not limited to the work shown on the electrical drawings. Refer to site, architectural, structural and mechanical drawings, coordinate all such work to attain fully operational systems throughout the project. The intent of this specification is to provide a complete and operating electrical system in accordance with all Contract Documents.

1.2 WORK INCLUDED

Provide all labor, materials, services and skilled supervision necessary for the construction, erection, installation, connection, testing, and adjustment of all circuits and electrical equipment required by the Contract Documents, complete in all respects and ready for use.

1.3 SUPERVISION OF WORK

a. Electrical work shall be under the full supervision of a professional electrical engineer registered to practice in the Territory of Guam. Within 30 calendar days after the Contractor has received the Owner's Notice to Proceed, submit a certification from the Professional Engineer stating that the work will be done under his full supervision. At the conclusion of the work, prior to final inspection, submit certification that the work was done in accordance with electrical construction documents and the installation complies with the latest edition of the National Electrical Code.

1.4 COORDINATION OF WORK

a. Plan all work so that it proceeds with a minimum of interference with other trades. Coordinate all openings required for equipment and conduit required for work of other trades. Provide all special frames, sleeves and anchor bolts as required. Coordinate electrical work with the mechanical installation.

b. Work lines and established heights shall be in accordance with architectural drawings. Verify all dimensions shown and establish all elevations and detailed dimensions not shown.

c. Lay out and coordinate all work well in advance to avoid conflicts or interference with other work in progress so that in the event of interference, the electrical layout may be altered to

suit the conditions, prior to the installation of any work, and without additional cost to the Owner. Conflicts arising from lack of coordination shall be the contractor's responsibility.

d. Maintain all code required clearance around electrical equipment. Unless specifically noted otherwise, establish the exact location of electrical equipment based on the actual dimensions of equipment furnished.

1.5 COOPERATION WITH OTHER TRADES

a. Cooperate and coordinate all work of Division 16 with that of other trades; afford reasonable opportunity for the execution of their work. Properly connect and coordinate this work with the work of other trades at such time and in such a manner as not to delay or interfere with their work.

b. Examine the drawings and specifications for the general and mechanical work and the work of other trades. Coordinate this work accordingly.

c. Promptly report to the Engineer any delay or difficulties encountered in the installation of this work which might prevent prompt and proper installation, or make it unsuitable to connect with or receive the work of others. Failure to report shall constitute an acceptance of the work of other trades as being fit and proper for the execution of this work.

1.6 CODES, PERMITS AND FEES

a. Perform work in accordance with the National Electrical Code, applicable building ordinances, and other applicable codes, hereinafter referred to as the "Code". Where the Contract Documents exceed minimum requirements, the most stringent shall apply unless variance is approved.

b. Comply with all requirements for permits, licenses, fees, and codes. Obtain all required permits, licenses, inspections, and pay all fees required to perform the work described in the Contract Documents.

c. Comply with all requirements of the applicable utility authorities serving the project. Make all arrangements with the utility authorities for proper coordination of the work.

1.7 MATERIALS AND EQUIPMENT FURNISHED BY OTHERS

The electrical work includes the installation or connection of certain materials and equipment furnished by others. Verify installation details. Foundations for apparatus and equipment will be furnished by others unless otherwise noted or detailed.

1.8 CONTRACT DRAWINGS

The Contract Drawings are shown in part diagrammatic, and intend to convey the scope of work, indicating the intended general arrangement of equipment, conduit and outlets. Follow the drawings in laying out the work and verify spaces for the installation of materials and equipment based on actual dimensions of equipment furnished. Wherever a question exists regarding the intended location of outlets or equipment, circuiting, etc., obtain instructions from the Engineer before proceeding with the work.

1.9 EQUIPMENT OR FIXTURES

Equipment or fixtures shall be connected to provide circuit continuity in accordance with applicable codes whether or not each piece of conductor, conduit, or protective device is shown between such items of equipment or fixtures, and the point of circuit origin.

1.10 NEW EQUIPMENT AND MATERIAL

a. Unless otherwise specified, equipment and materials of the same type of classification, and used for the same purpose shall be products of the same manufacturer. Use only new and unweathered material.

b. Furnish products listed and classified by Underwriter's Laboratories, Inc.

1.11 APPLICABLE DOCUMENTS

a. Design, manufacture, testing and method of installation of all apparatus and materials furnished under Division 16 of the specifications shall conform to the latest publications or standard rules of the following:

Institute of Electrical and Electronic Engineers - IEEE
National Electrical Manufacturers' Association - NEMA
Underwriters' Laboratories, Inc. - UL
National Fire Protection Association - NFPA
American Society for Testing and Materials - ASTM
American National Standards Institute - ANSI
National Electrical Code - NEC
National Electrical Safety Code - NESC
Uniform Fire Code - UFC
International Building Code - IBC
Insulated Power Cable Engineers Association - IPCEA
American Institute of Steel Construction - AISC
Department of Public Works Standards, Government of Guam - DPW
Guam Fire Department Standards, Government of Guam - GFD
Guam Power Authority Standards, Government of Guam - GPA

GTA Standards - GTA

1.12 EXECUTION OF THE WORK

a. Install equipment and materials in neat and workmanlike manner and align, level and adjust for proper operation. Install equipment so that all parts are easily accessible for inspection, operation, maintenance, and repair.

b. Where damage, marring or disfigurement has occurred, replace or refinish the damaged surfaces as directed, and to the satisfaction of the Engineer.

c. Provide the design, fabrication, and erection of all supplementary structural framing required for attachment of hangers or other devices supporting electrical equipment. Submit design/shop drawing to the Engineer for approval.

d. Outlet Location:

(1) Position of outlets: Center all outlets with regard to paneling, furring and trim. Symmetrically arrange outlets in the room. Satisfactorily correct outlets improperly located or installed. Repair or replace damaged finishes. Set outlets plumb and extend to the finished surface of the wall, ceiling or floor without projecting beyond same.

(2) Install all receptacles, switches, outlets, symmetrically, and where necessary, set the long dimension of the plate horizontal, or ganged in tandem.

1.13 SPECIAL CONSIDERATION

a. Cutting, Patching and Piercing

(1) Obtain written permission from the Engineer before cutting or piercing structural members.

(a) Use craftsmen skilled in their respective trades for cutting, fitting, repairing, patching of plaster and finishing of materials including carpentry work, metal work or concrete work required for by Division 16. Do not weaken walls, partitions or floor by cutting. Holes required to be cut in floors must be drilled or cored without breaking or spalling around the holes. Do all necessary patching and/or refinishing as instructed by the Engineer.

(b) Sleeves through floors and walls to be galvanized rigid steel flush with walls, ceiling or finished floors; size to accommodate the raceway.

(c) Use care in piercing waterproofing. After the part piercing waterproofing has been set in place, seal opening and make absolutely watertight.

(d) Provide baked white enamel painted spring-clipped escutcheon plates where exposed pipe passes through walls, floors, or ceilings. Cover sleeves and entire opening made for the pipe with escutcheon plates. Field applied paint finish shall match color of surrounding finish. Seal all conduit openings through floor slabs, masonry walls, and continuous partitions to make air and watertight. Tightly caulk space between conduit and abutting materials with fiberglass insulation and nonflammable sealant.

(2) Seal equipment or components exposed to the weather and make watertight and insect-proof. Protect equipment outlets and conduit openings with temporary plugs or caps at all times that work is not in progress.

(3) Equipment Identification

Identify each piece of equipment including disconnect switches and motor starters, with plastic laminate nameplates, black face with white core letters, having proper and complete identification. Clearly identify on the equipment served, and spell out the full name of the equipment, such as "Air Handling Unit AHU-1" and "Hot Water Cir. Pump P-1". Do not use abbreviated plan references such as "AHU-1" or "P-1".

(4) Equipment Access

Locate starters, switches, receptacles, and pull boxes to allow easy access for operation, repair and maintenance, and if concealed, provide access doors.

(5) Equipment Bases

Provide equipment bases on all floor-mounted equipment furnished under this Contract.

(6) Protection of apparatus, materials and equipment

Take all necessary precautions to properly protect all apparatus, fixtures, appliances, material, equipment and installations from damage of any kind. The Engineer may reject any particular piece or pieces of material, apparatus, or equipment which has scratches, dents or otherwise damaged.

(7) Operation and Maintenance Manuals

During the time of the Contract and before final acceptance of the electrical

installation, submit to the Engineer three copies of all descriptive literature, maintenance recommendations from the equipment manufacturer, data of initial operation, wiring diagrams and parts list of each item of electrical equipment installed under the Contract; submit all manufacturer's guarantees and warranties. Submittal shall include: switchboards, motor control centers, generators, and fire alarm system.

(a) Refer to Division 1 for additional requirements.

b. Painting Preparation

Prepare all exposed fittings, boxes, supports and panel boards for painting; remove traces of oil, grease and dirt. Employ all necessary precautionary methods to prevent scratching or defacing of all electrical apparatus and devices.

c. Painting

Exposed conduit, boxes installed after room has been painted, shall be painted to match room finish by this contractor.

(1) Corrosion Control

All corrosive metal surfaces, conduits/fittings, pipelines and structures shall be provided with corrosion inhibiting primer before installation. Appropriate surface preparation shall be made before application of primer.

d. Rust Prevention

Provide hot dip galvanized finish for all ferrous materials. In addition, outdoor installations shall be field painted with two coats of epoxy paint.

e. Tests

Provide all tests as outlined hereinafter, and other tests necessary to establish the adequacy, quality, safety, completed status, and suitable operation of each system. Tests shall be conducted in the presence of the Engineer.

(1) Ground Rod Test

Immediately after installation, test driven grounds with direct-reading single-test megger, utilizing the AC fall-of potential method and two reference electrodes. Orient the ground to be tested and two reference electrodes in a straight line spaced 50 feet apart. Drive the reference electrodes 5 feet deep. Disconnect the ground rod to be tested from other ground systems at the time of testing. Ground resistance for the

electrical service shall be 5 ohms or less. Ground resistance for communication system shall meet manufacturer's minimum requirements. Submit the results, date of test, and soil conditions, to the Engineer in writing, immediately after testing.

(2) Insulation Resistance of Conductors.

f. Seismic Consideration

Installation shall meet Seismic Zone 4 requirements.

g. Wind load Consideration

Installation exposed to outdoors shall be designed to withstand 170 mph sustained wind load.

1.14 QUALITY ASSURANCE

a. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Division.

b. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Division in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

1.15 ELECTRICAL SERVICE

a. Electrical service to the building is as indicated on the drawings.

b. Make all necessary arrangements with the serving utilities, and pay all costs and fees, assessed to the project by the serving utilities. All work shall be in accordance with serving utilities standards and subject to their approval. Coordinate the installation of service entrance equipment with GPA prior to start of construction.

1.16 PRODUCT HANDLING

Comply with pertinent provisions of product handling.

1.17 WARRANTY

Provide one year warranty on all labor and materials.

1.18 AS-BUILT DRAWINGS

a. The Contractor shall maintain at the site one copy of all Drawings, Specifications, Addenda, approved Shop Drawings, Change Orders, and other modifications, in good order and marked to record all changes made during construction. These shall be made available to the Engineer.

b. At the conclusion of the work, the Contractor will be furnished by the Engineer, at the Contractor's expense, a set of reproducible made from original contract plans. The Contractor shall then incorporate all changes made, as recorded, into the set of reproducible in a clear, legible and reproducible manner. All feeders, main alarm and communication lines, service entrance, and stub-outs shall be dimensionally located within the building structure. As a condition for acceptance of work, "as-built" reproducible shall be signed by Contractor attesting that all changes have been incorporated, dated and delivered to the Engineer.

1.19 SPARE PARTS AND MAINTENANCE PRODUCTS

a. Provide spare parts, maintenance, and extra Products in quantities specified in individual specification sections.

b. Deliver to Engineer; obtain receipt prior to release of payment.

END OF SECTION 16050

SECTION 16052

CONTRACTOR-FURNISHED EQUIPMENT AND MATERIALS

3B.1 GENERAL. The electrical equipment and materials included in this section shall be designed, selected, and sized as required for the specific application of equipment or materials to be furnished and installed by the Contractor. The equipment and materials are in addition to those specified elsewhere and are necessary to make a complete operational installation as intended by the drawings and these specifications.

All necessary grout, supports, and miscellaneous material required for a complete installation of the equipment shall be furnished and installed by the Contractor.

These specifications covering Contractor-furnished equipment and materials describe the type, functions, and general arrangements desired. The scope of these specifications does not necessarily cover all design details and features.

3B.2 ENGINEERING DATA. The Contractor shall submit data to the Owner covering all equipment and fabricated materials to be furnished under these specifications. The engineering data shall be submitted no later than 30 days after award of contract.

3B.3 CORRECTION OF ERRORS. Equipment and materials shall be complete in all respects within the limits herein outlined. All errors or omissions required to be corrected in the field shall be done by the manufacturer or his duly authorized representative at the Contractor's expense. All corrective measures shall be subject to the approval of the Owner.

3B.4 NAMEPLATES. The Contractor shall furnish and install nameplates for all equipment installed by him including Owner-furnished equipment, unless already furnished. Nameplates for equipment in the control building shall be made of laminated black phenolic engraving stock with white core. Nameplates to be installed outdoors in the switchyard shall be assembled from replaceable letter/number blocks or Owner approved equal consisting of black characters on a white or yellow background. The blocks shall be fade resistant and shall be assembled in galvanized steel or aluminum frames.

All items of equipment shall have nameplates. In addition, nameplates shall be provided for all panelboards, cabinets, junction boxes, etc. Termination structures shall be labeled with the appropriate line and feeder numbers and phase designations. Phase designations shall also be installed on the load side of all disconnect switch structures and at all PT structures.

Engraved nameplate lettering for indoor nameplates shall not be less than 1 inch square, bold engraved through the outside layer so that the letters are the color of the core.

The letter blocks shall be approximately 3 inches square.

All nameplates shall be attached to the equipment or structures with stainless steel hardware.

END OF SECTION 16052

SECTION 16351

34.5-KV METAL-CLAD SWITCHGEAR

PART 1 GENERAL

1.1 SCOPE

1.1.1 This section includes the requirements for the design, manufacture, factory testing and delivery and installation of indoor metal-clad switchgear and associated equipment. The switchgear shall meet the requirement of ANSI C37. The switchgear shall consist of the following equipment in accordance with the single-line circuit diagram:

- Line circuit breaker equipment
- Bus tie circuit breaker equipment
- Sparing bus with removable links and a tap section for a mobile substation
- Provisions for connection of a future line breaker to the main bus
- Transformer circuit breaker equipment
- Protective relaying equipment and devices
- Control and status devices
- Auxiliary compartments
- Accessories and material
- Disconnect Switches

1.1.2 Zone 4 seismic requirements shall apply. ANSI MC8.1 temperature and humidity requirements shall also apply.

1.1.3 Equipment layout and footprint Requirements: It is mandatory to adhere to the equipment layout and footprint shown on the Drawing. No deviations allowed due to site constraints. Contact Myers Power Products, Inc., Ontario, CA for equipment information.

1.2. CONFORMANCE TO STANDARDS AND SPECIFICATIONS

The metal-clad switchgear shall meet the requirements of the following standards and specifications, including the latest revisions with respect to material design and tests.

1.2.1 Applicable Standards

Provisions of the following standards shall apply:

ANSI/IEEE C37	Medium Voltage Metal-clad Switchgear
NEMA SG2	High Voltage Fuses
NEMA SG4	AC High-Voltage Circuit Breakers

NEMA SG5	Power Switchgear Assemblies
NEMA SG6	Power Switching Equipment
ANSI C57.13	Requirements for Instrument Transformer
ICEA	Specifications for Wire and Cable
NEC	Latest version of the National Electrical Code
NESC	Latest version of the National Electrical Safety Code
E11	Electrical Indicating Instruments.

1.2.2 Deviation and Non-Conformance Requirements

1.2.2.1 Deviations from this specification or changes in materials or design after the Purchase Order has been placed must be approved by the GPA Engineering Department and acknowledged by a Purchase Order Amendment.

1.2.2.2 Units received with deviations or non-conformances which are not acknowledged as specified in Sub-Paragraph 2.2.1 are subject to rejection. The Supplier is responsible for any corrective action including but not limited to materials, labor and transportation necessary to dispose of, or make the units conform to the specification.

1.2.2.3 Notification of defects discovered before or after installation that are believed to be inherent to manufacturing problems or workmanship shall be made and forwarded to the Supplier. The description of the item, documentation of the problem and the described information, disposition and/or follow-up (as appropriate) that GPA expects from the Supplier will be specified. The Supplier's response shall be made within thirty (30) days unless an extension is acknowledged and approved in writing by the GPA Manager of Engineering.

1.2.2.4 GPA shall be allowed two (2) weeks to review and approve drawings without affecting the shipping date. Delays in delivery due to drawings which are not approved during this review period are the responsibility of the Supplier.

1.2.3 Warranty

The Supplier shall warrant the satisfactory and successful operation of the apparatus furnished under this specification at the rating, under the conditions, and for the service specified for a period of not less than one (1) year. The Supplier shall further warrant the apparatus against defects of design, material and workmanship.

1.3 SUBMITTALS

1.3.1 Equipment outline drawings shall be submitted for approval within 30 days after Notice to Proceed. The remaining Shop Drawings shall be submitted within 60 days after Notice to Proceed. GPA will provide the successful bidder samples for three line and DC Schematics and preferred format for inter-connection diagrams as a guide.

1.3.2 Shop Drawings and data shall include the following:

a. General arrangement, floor plan, elevations and sections, anchor bolt details, overall dimensions and weights.

b. Interior structural drawings, elevations and sections of main bus, sparing bus, breakers and potential transformers.

c. A complete set of ac and dc schematic diagrams, one for each piece of equipment, including, but not necessarily limited to the following:

(1) Protection and controls
(2) Breaker controls
(3) Auxiliary equipment controls
(4) Communications and SCADA

d. Current transformer data, including excitation and ratio correction factor curves and mechanical and thermal short-term ratings.

e. Nameplate data.

f. Wiring diagrams with terminal block and device connections for each panel and cubicle. Tabular format is not acceptable.

g. Interconnection diagrams for panels and for external devices and field equipment.

h. Potential transformer data.

i. Notes and symbols.

j. Bill of materials and manufacturers catalog sheets clearly marked.

k. Three-line diagram.

l. One-line diagram.

m. Panel layout drawing.

n. Other drawings, diagrams, and instructions required for installation, operation and maintenance of the equipment.

1.3.3 Instructions for installation shall be submitted within 90 days after Notice to Proceed.

1.3.4 Operations and maintenance manuals with a section on troubleshooting shall be submitted 30 days prior to shipment.

1.3.5 Number of Copies

a. Submit five (5) copies each of shop drawing, pre-printed manufacturers' data, brochures and suppliers' information for review and approval. Electronic copies may be submitted if approved by the Owner.

b. After approval and manufacturing of equipment, submit one (1) reproducible transparency and five (5) prints of each shop drawing which has been specifically prepared for the Work. Indicate on the drawings that the drawings reflect the as-built condition of the equipment.

c. Submit five (5) copies of operations and maintenance manuals with a section on trouble shooting and instructions for installation.

d. Submit one (1) copy of the shop drawings on AUTOCAD 2005 using CD-ROM.

1.4. QUALITY ASSURANCE

1.4.1 Factory Tests

Not less than 30 days prior to factory tests, a factory test plan shall be submitted to the Owner for approval. Each item of electrical equipment and similar equipment supplied as spare parts, shall be given the manufacturer's routine factory tests and also other tests as specified, to ensure successful operation of parts of the assemblies. The factory test equipment and the test methods used shall conform to the applicable requirements of ANSI, IEEE and NEMA standards. Five certified copies of the reports of production tests, including complete test data shall be submitted to the Owner. Factory tests will be witnessed by the Owner. Contractor shall be responsible for cost of travel, meals, and accommodations for two (2) GPA personnel for a minimum of three (3) days, or days required to perform and witness a comprehensive Factory Acceptance Testing.

1.4.2. Assembly Tests

Units of the switchgear shall be assembled at the factory and checked for alignment and fit. Each circuit breaker to be supplied with the switchgear assembly shall be installed in the assigned unit after the switchgear has been fully assembled. Checks shall include correct operation of shutters, interlocks, auxiliary contacts, racking mechanisms and for ease of

installation and withdrawal of circuit breakers. Wiring shall be given point-to-point circuit continuity tests and shall be subjected to dielectric tests in accordance with requirements of ANSI Standard C37.20. The control switches shall be checked for proper contact operation. Device markings, nameplate markings, conductor identification and the scale of meters and instruments shall be checked.

1.4.3 Functional Tests

Current and potential tests shall be made on relays, instruments, meters and transducers for proper operation, direction and calibration. Operational tests shall be performed to verify the functional controls.

1.4.4 Factory Test Reports

Five (5) copies of certified test results shall be provided to the Owner within 30 days after performance of factory tests.

PART 2 PRODUCTS

2.0 RATING

2.1 DESCRIPTION

2.1.1 The switchgear shall be rated 34.5 kV and shall be suitable for operation on a solidly-grounded system rated 34.5 kV, 3-phase, 4-wire, 60 Hz. The main bus shall be rated at 2,500 amperes-continuous. Basic insulation level shall be 150 kV.

2.1.2 Equipment and materials shall be the products of manufacturers regularly engaged in the production of such equipment and materials.

2.1.3 The switchgear arrangement and dimensions shall be as specified in the design drawings.

2.1.4 Switchgear manufacturer shall provide lifting mechanism for breakers and VT drawout.

2.1.5 The preferred manufacturer is “Myers” Power Products Inc.

2.2 CIRCUIT BREAKERS

2.2.1 The 34.5 kV circuit breakers shall be of the oil-less type and be 3-pole, single throw, trip free, drawout-type breakers, rated on the symmetrical current basis. Each breaker shall have its characteristics based on a 15 second close-open duty cycle,

and shall be capable of interrupting its rating in 5 cycles or less from the time the trip coil is energized until the arc is extinguished.

2.2.2 The circuit breaker closing shall be operated by a stored energy mechanism, which is normally charged by an electric motor, but which can also be charged by a manual handle for emergency manual closing or testing. The power supply for the stored energy mechanism shall be 125 VDC.

2.2.3 The circuit breaker control voltage shall be 125 VDC.

2.2.4 Each circuit breaker shall be designed specifically for installation in the breaker compartment, and breakers of like ratings shall be completely interchangeable. Each breaker shall be self-contained, equipped with self-coupling primary and secondary disconnect contacts, and with either fixed and swivel casters or fixed casters and a fifth wheel accessory, or a maintenance and handling device to permit easy mobility. Provisions shall be made and accessory materials and equipment furnished to permit complete disconnection of the breaker from the line and bus and testing of the breaker within the switchgear compartment. Breakers shall be mechanically interlocked to ensure that the breaker is tripped before being withdrawn from or inserted into the connected position.

2.2.5 The breakers shall have the following features:

a. sturdy, self-aligning, silver-plated, primary disconnect contacts with high contact pressure. The circuit breaker element, primary disconnect shall be an integral part of the element.

b. auxiliary switch contacts connected to the mechanism of each breaker. A minimum of 10 "a" and 10 "b" contacts for the Owner's use shall be supplied and shall be wired to terminal blocks. Contacts shall be field changeable from "a" to "b" and vice versa.

c. an easy-to-read position indicator located on the front of the equipment.

d. a manual means for tripping.

e. trip free and non-pumping operation.

f. an operations counter.

g. the preferred manufacturer is “SIEMENS”.

2.2.6 The circuit breakers shall meet their ratings as listed in ANSI C37.06. Principal

breaker ratings shall be as follows:

a.	Rated maximum voltage, kV	38
b.	Withstand test voltages -	
	Low frequency RMS, kV	80
	Impulse crest, kV	150
c.	Rated continuous current, Amperes:	
	Line	2,000
	Transformer	2,000
	Bus Tie	2,500
d.	Rated short-circuit current at rated maximum voltage, symmetrical Amperes, RMS	40,000
e.	Maximum symmetrical interrupting capability, Amperes RMS	64,000
f.	Rated Short Time Current: Three second Amperes	40,000
g.	Minimum number of trip coils per breaker	2 each

2.3 ENCLOSURE

2.3.1 The switchgear shall have a suitable framework of structural steel to provide self-supporting rigid and stable structures. Channel base members shall be provided as part of the frames for proper alignment. The panel and structure shall be sufficiently rigid to support the equipment without vibration and shall be sized as shown on the Contact Drawings.

2.3.2 The panels and enclosure shall consist of selected sheets of smooth sheet steel. The panels shall be all the same size for front, rear and top alignment. Sheet steel shall not be less than No. 11 US Standard Gauge, forming structural shapes or having bent angle or channel edges with corner seams welded and ground smooth. Stiffeners shall be provided as required. The exposed exterior surfaces shall not be drilled or welded for attaching wires or devices if holes or fastenings will be visible after installation. Vertical wiring trough shall be provided on both sides of panels. Doors to each enclosure shall be the same material and thickness as the housing sheets. Doors shall be braced or constructed so as to hang true and prevent warping. Doors shall have a 1 inch allowance from the floor. Hinges shall be the type

which will permit the panels or doors to swing out not less than 105 degrees. Doors shall be provided with latches to ensure complete closure of doors. Ventilated openings shall be grill or louver type and provided with corrosion-resistant screens to prevent entrance of insects and rodents. Lights shall be provided within each enclosure.

2.4 BUSES

2.4.1 Main Bus

The main bus shall be copper, rated 2,500 amperes. The bus shall be silver-plated at joints and tap points, installed in a separate compartment from other wiring, and insulated along its entire length with high dielectric strength, flame-retarding, and self-extinguishing, moisture resistant material. Suitable insulation covers shall be provided for bus joints. Bracing shall be provided as required for the bus to withstand short circuit current equal to the momentary rating of the breakers furnished with the switchgear.

2.4.2 High Voltage Connections

High voltage connections between the main bus and the circuit breaker, disconnecting devices, the current transformers, and the potheads shall be furnished with material installed. Connections shall be made of copper bar insulated between terminals with insulation comparable to that required for the main bus bars. The cross-section of bars and joints shall be uniform and smooth to permit a flow of current equal to the full load rating of the breaker without excessive temperature rise. Joints shall be silver-plated and bolted. Joints shall be relieved of voltage stress by metallic gauze or other suitable conducting material, and insulated with tape and glyptal to provide insulation levels equal to or better than those of the main insulated buses. High voltage connections between the main bus or breaker load terminals and fixed studs of potential transformer assemblies shall be made with high voltage cable having insulation coordinated with basic impulse levels required for the switchgear. Supports, bushings, terminal lugs and joint insulation shall be furnished as required, and the leads installed to form a complete installation.

2.4.3 Ground Bus

Copper ground bus shall be 1/4-inch by 2-inches solidly connected to each switchgear unit and extended into the power cable entrance compartment of each unit. Ground bus shall be equipped with a clamp connector for 4/0 - 500-kcmil copper cable. Provisions for external ground connections shall be provided at each end of the bus. Materials for interconnecting the ground bus on adjacent shipping groups shall be provided, as required. Bars of the various sections shall be bolted

together to form an integral ground for the entire switchgear. At least 3 studs shall be provided on the bar for connection of the external station ground.

2.4.4 Sparing Bus

The sparing bus shall be same as the main bus.

2.4.5 Access

Removable panels shall be provided for access to the bus compartment.

2.5 INSTRUMENT TRANSFORMERS

2.5.1 Voltage transformers shall be rated for 200 kV BIL with ANSI accuracy classification of 0.3 at burdens W, X, Y and Z. Potential transformers shall be dry-type drawout or tilt-out mounted and equipped with high interrupting capacity current limiting fuses. The voltage transformers shall be dual-ratio rated at 300/175:1.

2.5.2 Current transformers shall be the toroidal type, suitable for metering or relaying as required. Metering current transformers shall have an accuracy rating equal to or better than 0.3B-0.1, 0.3B-0.2, 0.3B-0.5, 0.3B-1 and 0.3B-2. Multi-ratio current transformers for relaying and metering shall be of C200 relaying accuracy minimum or as determined by CT saturation calculations. There shall be two sets of current transformers on each side of the power circuit breaker.

2.6 SURGE ARRESTERS

Surge arresters shall be connected to each circuit conductor on the line side of the associated circuit breaker. The arresters shall have the MCOV rating of 30 kV.

2.7 WIRING AND ACCESSORIES

2.7.1 The metal-clad switchgear shall be completely wired at the factory, ready for installation and connection by others. Inter-panel wiring required between shipping groups shall be brought to terminal blocks on adjacent panels necessitating only on-site reconnections of factory-supplied jumpers. Terminal blocks and jumper cables shall be properly identified for assembly. Unused terminals on relays and auxiliary contacts shall be brought to conveniently located terminal blocks. Line and transformer power cables and all control and meter connections will enter from the bottom. The incoming cables for the line breaker will consist of two (2) 1,000 kcmil cables per phase. The manufacturer shall ensure that sufficient vertical and horizontal clearances are provided for training and terminating these cables in the cable compartment without requiring excessive bending or the use of special adapter

plates furnished by the cable installer. Rubber insulators shall also be provided at the terminations of power cables. In addition, bracket supports for the cables shall be provided.

2.7.2 All secondary wiring shall be stranded. No. 12 AWG shall be used for control circuits, #10 for CT circuits and #16 for SCADA indication or as indicated in the design drawings. Switchboard wire shall be NEC type SIS, and rated for 600 volts. Insulation jacket shall be gray in color. Splices will not be permitted. Wires shall run in conduits, raceways or trays. Suitable, extra flexible wiring shall be provided over door hinges or other locations where leads may be subjected to flexing.

2.7.3 Ring-tongue terminals shall be used for secondary wiring. Spade, slotted spade, flanged spade, and hook terminals are not acceptable. The strength of the terminals shall be such that the terminals will not break during vibration of the equipment in which the terminals are installed. Ring-tongue terminals shall be Thomas & Betts Stakon.

2.7.4 Terminals shall have insulated ferrules. To assure positive electrical connections, and to avoid damage to the ferrule, it is mandatory that the crimping tool be used in accordance with manufacturer's instructions, and that the proper terminal and crimping tool be used for each wire size. Crimps shall be made with the crimp indentation opposite to the connector seam.

2.7.5 Miscellaneous accessories, such as resistors, fuses, fuse blocks, and capacitors not shown on the Contract Drawings but required for proper operation of the switchgear shall be furnished.

2.7.6 Terminal blocks for current transformer leads shall be 6-point and shall be provided with short-circuiting devices to permit removing or testing of wiring without opening the current transformer circuits. Leads from multi-ratio current transformers shall be brought out to the terminal blocks. Terminal blocks shall be Marathon Series 1600, or as approved by the Owner. Terminal blocks shall be provided for all wires leaving switchboard panels and shall have marking strips for Owner's 6-digit number identification system. Terminal blocks shall have washer head binding screw terminals, barriers between terminals, high flame retarding properties, mechanical toughness and high electrical strength. At least 20% spare terminals shall be provided on each panel. Each wire shall be identified at both ends with a permanently machine-embossed black identification on white plastic, heat-shrinkable, tubular slip-on marker.

2.7.7 Terminal blocks for grouping of SCADA wiring shall be thermo-plastic insulation type, rated 300 Volts, with test socket screws, knife switch contacts and shall be mounted on rails.

The marking system shall be Dekafix consecutive vertical numbering system and Peso white blanks for Owner's marking. Terminal blocks shall be furnished complete with mounting rails, end brackets, end plates, partitions and test equipment. Wiring to the SCADA terminal blocks shall be made with No. 16 wire minimum.

2.7.8 Wiring Format

a. All terminals shall be numbered, and the numbers shall correspond to the numbers on the wiring diagram.

b. All wires shall be identified at their termination points with the opposite end designation identification by labeled plastic sleeves or equal. Identification shall correspond to the lettered device, numbered terminal format of the wiring diagrams.

2.7.9 System Phase Rotation. The system phase rotation for the island-wide system is GPA C-B-A or NEMA 1-2-3 and all equipment purchased under this contract shall be wired and connected NEMA 1-2-3. All phase markings shall be NEMA 1-2-3. Instrument and relay arrangement shall be 1-2-3 left to right and top to bottom with neutral relays underneath phase grouping. GPA will make the external connections of the incoming and outgoing lines such that GPA C-B-A is connected to NEMA 1-2-3. Phase markings C-B-A shall be reserved for GPA's use.

2.8 NAMEPLATES

Nameplates shall be furnished and installed for panels, switches, relays and devices, including those internally mounted, and shall be of laminated plastic or formica with white letters on black background and shall be sized for easy reading. Nameplates shall be securely fastened to the panel with stainless steel panhead screws to prevent detachment and loss. Nameplate data shall be submitted for Owner's approval. Designations shall be machine engraved in upper case letters and shall be centered on the nameplates. Each metal-clad switchgear unit shall be provided with a circuit identifying nameplate, letters approximately 3/4-inch high, and mounted at the top of the switchgear.

2.9 MIMIC BUS AND DEVICES

Mimic bus shall be 3/8-inch in width and shall be anodized aluminum, approximately 1/16-inch thick, fastened to the panels with adhesive backing or blind metal fasteners. Mimic devices shall be made of the same materials as the bus, and shall indicate the required symbol. The Contractor shall use the Owner’s standard colors as follows:

Yellow 13.8 KV

Red	34.5 KV
Cyan	115 KV

2.10 CONTROL SWITCHES

2.10.1 Control switches shall be the rotary, cam-operated type with silver contacts and a positive means for maintaining contact position. Contact requirements shall be as shown on the Contract Drawings or as specified. Switch contacts shall be totally enclosed to prevent the accumulation of dust, grit, and foreign matter on the contact surface. The switches shall be GE type SB-1, Westinghouse type W-2, Electroswitch Series 24, or equal, and shall have operating handles, as follows:

a. Large red pistol-grip handles for power circuit breaker control switches.

b. Black oval handles with arrow for transfer, and auxiliary switches.

2.10.2 Control switches for circuit breakers shall be momentary contact, spring-return type for both trip and close operation. Operation indicators showing the last operation shall be provided.

2.10.3 The switches shall have escutcheon plates marked as specified with standard circuit designation, except where otherwise specified, and shall be as follows:

a. Escutcheon plate for circuit breaker control switches, 52CS, shall read "TRIP-CLOSE".

b. Escutcheon plate for supervisory selector switch, 43L/R shall be LOCAL-REMOTE.

2.11 INDICATING LIGHTS

Indicating lights shall be the manufacturer's standard transformer type units 125-volt DC input utilizing low-voltage LEDs of the colors indicated: red for breaker close, green for breaker trip. Provide indicating lights that are capable of being re-lamped from the switchgear front. Indicating lights utilizing resistors in series with the lamps are not permitted, except in direct-current control circuits. For all breaker control switches and hand reset lockout relays use trip monitors in lieu of standard indicating lights.

2.12 AUXILIARY RELAYS

Control, timing, auxiliary and SCADA interposing and command relays shall operate on 125 VDC. Relay contacts shall have a minimum voltage rating of 480 Volts and a continuous current capacity of not less than 10.0 amperes AC. The contacts shall be field reversible and capable of breaking 20 amperes at 120 VAC and 5 amperes at 125 VDC. Contact arrangement shall be as required for the specified control. The control and auxiliary relays shall be utility grade. Time delay relays shall be Agastat Series 7000.

2.13 SUBSTATION METERING

Power delivery measurement of each power transformer shall be made via Schweitzer Engineering Laboratories' SEL-735, PN 0735VX10944CXXXXXX26101XX .

2.14 TEST SWITCHES AND DEVICES

Current and potential test switches and test plugs shall be provided with the test switches semi-flush mounted on the switchboard. Test switches shall be connected to the appropriate circuits to permit the checking and calibrating of meters, instruments or relays individually against portable standards connected in series with the instruments or relay undergoing tests, under service conditions or by means of a phantom load. The switches and plugs shall permit "in service" testing as well as calibration and checking of instruments, meters and relays from separate sources of power. Provisions shall also be included for connecting current measuring devices in series with the current circuits of the switches. Switch blades shall be separated by insulated barriers and each switch handle shall be provided with a recessed section for inserting circuit identification cards. Switches shall automatically short circuit current transformer circuits so they cannot be opened inadvertently. Current and potential test switches shall be ABB type FT-1.

2.15 TRIP CIRCUIT MONITOR

The trip circuit monitor shall be SEL-2652A, PN: 2652A1XX – red, 125 VDC nominal, 250 ms time delay. The SEL-2652A is a panel-mounted relay that contains a series LED for visual indication and blocking diodes for prevention of alarm indication when the breaker is opened. Trip circuit monitors shall be installed to monitor loss of DC for each circuit breaker and lock-out relay.

2.16 PROTECTIVE RELAYS

2.16.1 General

Protective relays shall be the projection- mounted, back connected, dustproof type, for mounting on a No. 11 United States Standard gauge metal panel. All protective

relays shall be manufactured by Schweitzer Engineering Laboratories. Trip contacts shall be designed for operation on 125 VDC. Each relay shall operate with instrument transformer ratios and connections as shown on the Contract Drawings under both normal and short-circuit conditions. Each overcurrent and differential relay shall provide continuous operation at the current coil tap ratings. Protective relays shall be the type and model indicated below. Substitutions are not acceptable.

2.16.2 Power Transformer Protection Relays

Primary transformer differential relays shall be a percentage differential type and shall have harmonic restraint. They shall be Schweitzer SEL-387A, Primary Relay PN: 0387A011323X34X.

Backup transformer differential relay shall be Schweitzer SEL-351A (PN 0351A0W323554XX). Wiring harnesses (PN WA03510WAC5A) shall be provided.

C273A cables for both relays for connection to SEL-3530 communication processor shall be provided.

2.16.3 Transmission Line Relays

Transmission Line Distance, Residual Time Overcurrent and Directional Ground Relays - Device 21/50/51/67/25/27/59. The relay shall be a packaged, 3-zone, phase distance relay with residual overcurrent and ground directional overcurrent elements. The relay shall have capabilities for fault locating and event reporting.

a. For transmission lines with no POTT scheme infrastructure capability, Schweitzer SEL-311C-1 (PN 0311C113A3E54X2) shall be used as the primary relay. Schweitzer SEL-311A (PN 0311A0W323254XX) shall be utilized as the backup/breaker failure relay. Wiring harnesses shall be provided for the SEL-311A, and WA0311C0WAC5A. Schweitzer C273A cables for both relays shall be provided for connection to SEL-3530 communication processor.

b. For transmission lines with POTT scheme infrastructure capability, Schweitzer SEL-311L (PN 0311L73DD3254X4XX) shall be used as the primary relay. Another Schweitzer SEL-311L shall be utilized as the backup/breaker failure relay. Single mode fiber optic communication shall be utilized between the relays. Additionally, C273A cables for both relays shall be provided for connection to SEL-3530 communication processor.

2.16.4 Bus Differential Relays - Device 87B

Primary and backup bus differential relays shall be Schweitzer SEL-387 (PN

03875Y3X532X4XX). A primary and a backup relay shall be provided. Wiring harnesses shall be provided (PN WA03870YAC5A) as well as C273A cables for both relays for connection to the SEL-3530 communication processor.

2.16.5 Bus Tie Overcurrent Protection

Bus tie primary protection relay shall be Schweitzer SEL-351-6 (PN 035165A3E54XX2). Backup protection relays shall be Schweitzer SEL-351A (PN 0351A0W323554XX). Wiring harnesses shall be provided. Communication cables, C273A, shall be provided for connections to the SEL-3530 communication processor.

2.16.6 Lockout Relays - Device 86

Lockout relays shall be electrical trip, hand-reset, 125 volt dc auxiliary lockout relay type. Relays shall be multi-contact and shall be GE type HEA or Electroswitch Series 24. Spare contacts of 25% shall be provided for all lockout relays.

2.16.7 Communication Processor

The communication processor shall be Schweitzer Type SEL-3530 (PN 35303B0D1313X0XXXXXX) to provide real-time automation control functions in conjunction with the SCADA system specified in Section 16704. The communication processor shall be capable of communicating with other SEL protective relays for control, monitoring and IRIG-B timing signal interfaces. The communication processor shall include optional input/output Board (24 inputs, 8 output contacts), 10/100 Base-T HMI, IEC 61850, and 17 serial ports. No substitutions allowed.

2.16.8 POTT Scheme

For short transmission lines the following POTT schemes shall be in effect.

a. Fiber Optic Communication

H&L 570E-16 transceiver, 16-RS232 ports, Ethernet port, single mode ST connection, dual voltage input 120 VAC or 125 VDC shall be provided for substations equipped with fiber optic communications.

2.17 PAINTING

The switchgear enclosure shall be thoroughly cleaned of rust, welding scale and grease, and shall be treated to effectuate a bond between the metal and paint which will prevent the formation of rust under the paint. A priming coat shall be applied immediately after the bonding treatment. A final finish shall consist of not less than one coat for concealed surfaces and two coats for exterior surfaces. Final

finish shall be light gray, ANSI Color No. 70. The interior shall be painted with 2 coats of white enamel.

2.18 SPACE HEATERS

1. Equip each section of the switchgear assembly with externally energized space heaters to provide approximately 4 watts per square foot of outer surface area and designed for operation at 120VAC. Locate heaters at the lowest portion of each space to be heated. Cover terminals. Use thermostats to regulate the temperature.

2. Provide heaters that are installed and operable at the time of shipment so that the heaters can be operated immediately upon arrival at the site, during storage, or before installation. Provide connection locations that are marked prominently on drawings and shipping covers and that have temporary leads for storage operation.

2.19 ACCESSORIES AND SPARE PARTS

Accessories, special tools and spare parts required for proper maintenance and testing of the equipment, circuit breakers and devices shall be provided with the switchgear and shall be turned over to GPA upon the completion of the project. Accessories and spare parts shall include the following:

Ten switchboard indicating lamps or LEDs.

One color cap for indicating lamps for each ten or less of each color and type used.

Indicating lamp pullers.

Color caps of each color for indicating lamps.

Twenty control spare fuses of each rating used.

Resistors and lamp sockets for indicating lamps.

Breaker test cabinet to facilitate operation of a circuit breaker out of its cubicle for test purposes.

Test jumper for testing the breaker when removed from the cubicle.

1 each trip coil for every 4 power circuit breaker provided.

Blank nameplates of each size used.

Gallons of touchup paint in one quart cans.

Closing lever for manual operation.

Levering device for breaker positioning.

Lifting truck for inserting and removing breaker and voltage transformer from switchgear compartment

Turning dolly for handling breaker.

Transport truck for handling breaker outside the cubicle, if required.

Crank for manually charging the stored energy closing mechanism.

Spare fuses for potential transformers.

1,200-Ampere grounding and test device with provisions for independently locking each access door with a padlock without remote control if applicable.

Special tools required for proper maintenance, testing and inspection of the equipment.
Spare vacuum bottle, if applicable.

Test plugs and cables for meters and relays.

2.20 DISCONNECT SWITCHES

2.20.1 Disconnect switches shall be provided as an integral part of the switchgear lineup s shown.

2.20.2 Disconnect switches shall be rated for 38 kV, 1,200A, 3-pole, no-load break, non-fused, manual operation, and shall include a handle interlocked with operating mechanism, viewing window, and auxiliary contacts for future remote indication.

2.21 PACKING AND SHIPPING REQUIREMENTS

2.21.1 Because of severe transportation conditions, the Supplier shall pay particular attention to the proper packaging and bracing of the apparatus to assure its safe arrival.

2.21.2 The Supplier shall prepare all materials and equipment for shipment in such a manner as to protect from damage in transit. All small parts and unit components shall be separately boxed or bundled to prevent galling due to rubbing of one part against another. Each item, box or bundle shall be plainly and individually identifiable for content according to item number, GPA P.O. Number, and Supplier's Identifying Number.

2.21.3 A complete itemized Bill of Lading, which clearly identifies and inventories each assembly,

sub-assembly, carton, package, envelope, etc., shall be furnished and enclosed with each item or items at the time of shipment.

2.21.5 The switchgear shall be shipped in crates containing not more than two units each.

PART 3 EXECUTION

3.1 GENERAL

A. Fully assemble switchgear and install in accordance with manufacturer's instructions.

B. Remove wedges, ties, and shipping blocks.

C. Do not distort frames. Follow manufacturer's instructions for handling, installing and operating equipment. Ensure personnel working with the equipment fully understand the procedures involved.

D. Make equipment assembly connections between shipping units, including bolted connections to mechanically assemble units and installation of splice plates, bases, and throats, as provided.

E. Make electrical connections between shipping splits per manufacturer's instructions. Use proper calibrated torque wrench when terminating feeder cables.

F. Make ground connections.

G. Ensure doors and drawout devices are properly aligned and operate smoothly. Correct all misalignment to the Owner's satisfaction.

H. Remove short-circuiting links from current transformers after checking that secondary circuits are complete.

I. Verify that protective relays are properly set according to the relay coordination studies.

3.2 FIELD TESTING AND COMMISSIONING

Refer to Sections 16998 and 16999.

END OF SECTION 16351

SECTION 16352

13.8-KV METAL-CLAD SWITCHGEAR

PART 1 GENERAL

1.1 SCOPE

1.1.1 This section includes the requirements for the design, manufacture, factory testing and delivery and installation of indoor metal-clad switchgear and associated equipment. The switchgear shall meet the requirement of ANSI C37. The switchgear shall consist of the following equipment in accordance with the single-line circuit diagram:

- Feeder circuit breaker equipment
- Bus tie circuit breaker equipment
- Sparing bus with removable links and a tap section for a mobile substation
- Provisions for connection of a future line breaker to the main bus
- Transformer circuit breaker equipment
- Protective relaying equipment and devices
- Control and status devices
- Auxiliary compartments
- Accessories and material
- Disconnect Switches

1.1.2 Zone 4 seismic requirements shall apply. ANSI MC8.1 temperature and humidity requirements shall also apply.

1.13 Equipment layout and footprint Requirements: It is mandatory to adhere to the equipment layout and footprint shown on the Drawing. No deviations allowed due to site constraints. Contact Myers Power Products, Inc., Ontario, CA for equipment Information.

1.2. CONFORMANCE TO STANDARDS AND SPECIFICATIONS

The metal-clad switchgear shall meet the requirements of the following standards and specifications, including the latest revisions with respect to material design and tests.

1.2.1 Applicable Standards

Provisions of the following standards shall apply:

ANSI/IEEE C37	Medium Voltage Metal-clad Switchgear
NEMA SG2	High Voltage Fuses
NEMA SG4	AC High-Voltage Circuit Breakers

NEMA SG5	Power Switchgear Assemblies
NEMA SG6	Power Switching Equipment
ANSI C57.13	Requirements for Instrument Transformer
ICEA	Specifications for Wire and Cable
NEC	Latest version of the National Electrical Code
NESC	Latest version of the National Electrical Safety Code
E11	Electrical Indicating Instruments.

1.2.2 Deviation and Non-Conformance Requirements

2.2.1 Deviations from this specification or changes in materials or design after the Purchase Order has been placed must be approved by the GPA Engineering Department and acknowledged by a Purchase Order Amendment.

2.2.2 Units received with deviations or non-conformances which are not acknowledged as specified in Sub-Paragraph 2.2.1 are subject to rejection. The Supplier is responsible for any corrective action including but not limited to materials, labor and transportation necessary to dispose of, or make the units conform to the specification.

2.2.3 Notification of defects discovered before or after installation that are believed to be inherent to manufacturing problems or workmanship shall be made and forwarded to the Supplier. The description of the item, documentation of the problem and the described information, disposition and/or follow-up (as appropriate) that GPA expects from the Supplier will be specified. The Supplier's response shall be made within thirty (30) days unless an extension is acknowledged and approved in writing by the GPA Manager of Engineering.

2.2.4 GPA shall be allowed two (2) weeks to review and approve drawings without affecting the shipping date. Delays in delivery due to drawings which are not approved during this review period are the responsibility of the Supplier.

1.2.3 Warranty

The Supplier shall warrant the satisfactory and successful operation of the apparatus furnished under this specification at the rating, under the conditions, and for the service specified for a period of not less than one (1) year. The Supplier shall further warrant the apparatus against defects of design, material and workmanship.

1.3 SUBMITTALS

1.3.1 Equipment outline drawings shall be submitted for approval within 30 days after Notice to Proceed. The remaining Shop Drawings shall be submitted within 60 days after Notice to Proceed. GPA will provide the successful bidder samples for three line and DC Schematics and preferred format for inter-connection diagrams as a guide.

1.3.2 Shop Drawings and data shall include the following:

a. General arrangement, floor plan, elevations and sections, anchor bolt details, overall dimensions and weights.

b. Interior structural drawings, elevations and sections of main bus, sparing bus, breakers and potential transformers.

c. A complete set of ac and dc schematic diagrams, one for each piece of equipment, including, but not necessarily limited to the following:

(1) Protection and controls
(2) Breaker controls
(3) Auxiliary equipment controls
(4) Communications and SCADA

d. Current transformer data, including excitation and ratio correction factor curves and mechanical and thermal short-term ratings.

e. Nameplate data.

f. Wiring diagrams with terminal block and device connections for each panel and cubicle. Tabular format is not acceptable.

g. Interconnection diagrams for panels and for external devices and field equipment.

h. Potential transformer data.

i. Notes and symbols.

j. Bill of materials and manufacturers catalog sheets clearly marked.

k. Three-line diagram.

l. One-line diagram.

m. Panel layout drawing.

n. Other drawings, diagrams, and instructions required for installation, operation and maintenance of the equipment.

1.3.3 Instructions for installation shall be submitted within 90 days after Notice to Proceed.

1.3.4 Operations and maintenance manuals with a section on troubleshooting shall be submitted 30 days prior to shipment.

1.3.5 Number of Copies

a. Submit five (5) copies each of shop drawing, pre-printed manufacturers' data, brochures and suppliers' information for review and approval. Electronic copies may be submitted if approved by the Owner.

b. After approval and manufacturing of equipment, submit one (1) reproducible transparency and five (5) prints of each shop drawing which has been specifically prepared for the Work. Indicate on the drawings that the drawings reflect the as-built condition of the equipment.

c. Submit five (5) copies of operations and maintenance manuals with a section on trouble shooting and instructions for installation.

d. Submit one (1) copy of the shop drawings on AUTOCAD 2005 using CD-ROM.

1.4. QUALITY ASSURANCE

1.4.1 Factory Tests

Not less than 30 days prior to factory tests, a factory test plan shall be submitted to the Owner for approval. Each item of electrical equipment and similar equipment supplied as spare parts, shall be given the manufacturer's routine factory tests and also other tests as specified, to ensure successful operation of parts of the assemblies. The factory test equipment and the test methods used shall conform to the applicable requirements of ANSI, IEEE and NEMA standards. Five certified copies of the reports of production tests, including complete test data shall be submitted to the Owner. Factory tests will be witnessed by the Owner. Contractor shall be responsible for cost of travel, meals, and accommodations for two (2) GPA personnel for a minimum of three (3) days, or days, required to perform and witness a comprehensive factory acceptance testing.

1.4.2. Assembly Tests

Units of the switchgear shall be assembled at the factory and checked for alignment and fit. Each circuit breaker to be supplied with the switchgear assembly shall be installed in the assigned unit after the switchgear has been fully assembled. Checks shall include correct operation of shutters, interlocks, auxiliary contacts, racking mechanisms and for ease of installation and withdrawal of circuit breakers. Wiring shall be given point-to-point circuit

continuity tests and shall be subjected to dielectric tests in accordance with requirements of ANSI Standard C37.20. The control switches shall be checked for proper contact operation. Device markings, nameplate markings, conductor identification and the scale of meters and instruments shall be checked.

1.4.3 Functional Tests

Current and potential tests shall be made on relays, instruments, meters and transducers for proper operation, direction and calibration. Operational tests shall be performed to verify the functional controls.

1.4.4 Factory Test Reports

Five (5) copies of certified test results shall be provided to the Owner within 30 days after performance of factory tests.

PART 2 PRODUCTS

2.0 RATING

2.1 DESCRIPTION

2.1.1 The switchgear shall be rated 15 kV and shall be suitable for operation on a solidly-grounded system rated 13.8 kV, 3-phase, 4-wire, 60 Hz. The main bus shall be rated for 2,000 amperes-continuous. Basic insulation level shall be 95 kV.

2.1.2 Equipment and materials shall be the products of manufacturers regularly engaged in the production of such equipment and materials.

2.1.3 The switchgear arrangement and dimensions shall be as specified in the design drawings.

2.1.4 Switchgear manufacturer shall provide lifting mechanism for breakers and VT drawout.

2.1.5 The preferred manufacturer is “Myers” Power Products Inc.

2.2 CIRCUIT BREAKERS

2.2.1 The 13.8 kV circuit breakers shall be of the oil-less type and be 3-pole, single throw, trip free, drawout-type breakers, rated on the symmetrical current basis. Each breaker shall have its characteristics based on a 15 second close-open duty cycle, and shall be capable of interrupting its rating in 5 cycles or less from the time the trip

coil is energized until the arc is extinguished.

2.2.2 The circuit breaker closing shall be operated by a stored energy mechanism, which is normally charged by an electric motor, but which can also be charged by a manual handle for emergency manual closing or testing. The power supply for the stored energy mechanism shall be 125 VDC.

2.2.3 The circuit breaker control voltage shall be 125 VDC.

2.2.4 Each circuit breaker shall be designed specifically for installation in the breaker compartment, and breakers of like ratings shall be completely interchangeable. Each breaker shall be self-contained, equipped with self-coupling primary and secondary disconnect contacts, and with either fixed and swivel casters or fixed casters and a fifth wheel accessory, or a maintenance and handling device to permit easy mobility. Provisions shall be made and accessory materials and equipment furnished to permit complete disconnection of the breaker from the line and bus and testing of the breaker within the switchgear compartment. Breakers shall be mechanically interlocked to ensure that the breaker is tripped before being withdrawn from or inserted into the connected position.

2.2.5 The breakers shall have the following features:

a. sturdy, self-aligning, silver-plated, primary disconnect contacts with high contact pressure. The circuit breaker element, primary disconnect shall be an integral part of the element.

b. auxiliary switch contacts connected to the mechanism of each breaker. A minimum of 10 "a" and 10 "b" contacts for the Owner's use shall be supplied and shall be wired to terminal blocks. Contacts shall be field changeable from "a" to "b" and vice versa.

c. an easy-to-read position indicator located on the front of the equipment.

d. a manual means for tripping.

e. trip free and non-pumping operation.

f. an operations counter.

g. The preferred breaker model is G.E. POWERVAC®.

2.2.6 The circuit breakers shall meet their ratings as listed in ANSI C37.06. Principal breaker ratings shall be as follows:

a.	Rated maximum voltage, kV	15
b.	Withstand test voltages -	
	Low frequency RMS, kV	36
	Impulse crest, kV	95
c.	Rated continuous current, Amperes:	
	Line	1,200
	Transformer	2,000
	Bus Tie	2,000
d.	Rated short-circuit current at rated maximum voltage, symmetrical Amperes, RMS	25,000
e.	Maximum symmetrical interrupting capability, Amperes RMS	36,000
f.	Rated Short Time Current: Three second Amperes	36,000
g.	Minimum number of trip coils per breaker	1 each

2.3 ENCLOSURE

2.3.1 The switchgear shall have a suitable framework of structural steel to provide self-supporting rigid and stable structures. Channel base members shall be provided as part of the frames for proper alignment. The panel and structure shall be sufficiently rigid to support the equipment without vibration and shall be sized as shown on the Contact Drawings.

2.3.2 The panels and enclosure shall consist of selected sheets of smooth sheet steel. The panels shall be all the same size for front, rear and top alignment. Sheet steel shall not be less than No. 11 US Standard Gauge, forming structural shapes or having bent angle or channel edges with corner seams welded and ground smooth. Stiffeners shall be provided as required. The exposed exterior surfaces shall not be drilled or welded for attaching wires or devices if holes or fastenings will be visible after installation. Vertical wiring trough shall be provided on both sides of panels. Doors to each enclosure shall be the same material and thickness as the housing sheets. Doors shall be braced or constructed so as to hang true and prevent warping. Doors shall have a 1 inch allowance from the floor. Hinges shall be the type which will permit the panels or doors to swing out not less than 105 degrees. Doors

shall be equipped with latches to ensure complete closure of doors. Ventilated openings shall be grill or louver type and provided with corrosion-resistant screens to prevent entrance of insects and rodents. Lights shall be provided within each enclosure.

2.4 BUSES

2.4.1 Main Bus

The main bus shall be copper, rated 2,000 amperes. The bus shall be silver-plated at joints and tap points, installed in a separate compartment from other wiring, and insulated along its entire length with high dielectric strength, flame-retarding, and self-extinguishing, moisture resistant material. Suitable insulation covers shall be provided for bus joints. Bracing shall be provided as required for the bus to withstand short circuit current equal to the momentary rating of the breakers furnished with the switchgear.

2.4.2 High Voltage Connections

High voltage connections between the main bus and the circuit breaker, disconnecting devices, the current transformers, and the potheads shall be furnished with material installed. Connections shall be made of copper bar insulated between terminals with insulation comparable to that required for the main bus bars. The cross-section of bars and joints shall be uniform and smooth to permit a flow of current equal to the full load rating of the breaker without excessive temperature rise. Joints shall be silver-plated and bolted. Joints shall be relieved of voltage stress by metallic gauze or other suitable conducting material, and insulated with tape and glyptal to provide insulation levels equal to or better than those of the main insulated buses. High voltage connections between the main bus or breaker load terminals and fixed studs of potential transformer assemblies shall be made with high voltage cable having insulation coordinated with basic impulse levels required for the switchgear. Supports, bushings, terminal lugs and joint insulation shall be furnished as required, and the leads installed to form a complete installation.

2.4.3 Ground Bus

Copper ground bus shall be 1/4-inch by 2-inches solidly connected to each switchgear unit and extended into the power cable entrance compartment of each unit. Ground bus shall be equipped with a clamp connector for 4/0 - 500-kcmil copper cable. Provisions for external ground connections shall be provided at each end of the bus. Materials for interconnecting the ground bus on adjacent shipping groups shall be provided, as required. Bars of the various sections shall be bolted together to form an integral ground for the entire switchgear. At least 3 studs shall be

provided on the bar for connection of the external station ground.

2.4.4 Sparing Bus

The sparing bus shall be same as the main bus.

2.4.5 Access

Removable panels shall be provided for access to the bus compartment.

2.5 INSTRUMENT TRANSFORMERS

2.5.1 Voltage transformers shall be rated for 110 kV BIL with ANSI accuracy classification of 0.3 at burdens W, X, Y and Z. Potential transformers shall be dry-type drawout or tilt-out mounted and equipped with high interrupting capacity current limiting fuses. The voltage transformers shall be dual-ratio rated at 120/70:1.

2.5.2 Current transformers shall be the toroidal type, suitable for metering or relaying as required. Metering current transformers shall have an accuracy rating equal to or better than 0.3B-0.1, 0.3B-0.2, 0.3B-0.5, 0.3B-1 and 0.3B-2. Multi-ratio current transformers for relaying and metering shall be of C200 relaying accuracy. There shall be two sets of current transformers on each side of the power circuit breaker.

2.6 SURGE ARRESTERS

Surge arresters shall be connected to each circuit conductor on the line side of the associated circuit breaker. The arresters shall have the MCOV rating of 12.7 kV.

2.7 WIRING AND ACCESSORIES

2.7.1 The metal-clad switchgear shall be completely wired at the factory, ready for installation and connection by others. Inter-panel wiring required between shipping groups shall be brought to terminal blocks on adjacent panels necessitating only on-site reconnections of factory-supplied jumpers. Terminal blocks and jumper cables shall be properly identified for assembly. Unused terminals on relays and auxiliary contacts shall be brought to conveniently located terminal blocks. Line and transformer power cables and all control and meter connections will enter from the bottom. The incoming cables for the line breaker will consist of two (2) 1,000 kcmil cables per phase. The manufacturer shall ensure that sufficient vertical and horizontal clearances are provided for training and terminating these cables in the cable compartment without requiring excessive bending or the use of special adapter plates furnished by the cable installer. Rubber insulators shall also be provided at the terminations of power cables. In addition, bracket supports for the cables shall be

provided.

2.7.2 All secondary wiring shall be stranded. No. 12 AWG shall be used for control circuits, #10 for CT circuits and #16 for SCADA indication or as indicated in the design drawings. Switchboard wire shall be NEC type SIS, and rated for 600 volts. Insulation jacket shall be gray in color. Splices will not be permitted. Wires shall run in conduits, raceways or trays. Suitable, extra flexible wiring shall be provided over door hinges or other locations where leads may be subjected to flexing.

2.7.3 Ring-tongue terminals shall be used for secondary wiring. Spade, slotted spade, flanged spade, and hook terminals are not acceptable. The strength of the terminals shall be such that the terminals will not break during vibration of the equipment in which the terminals are installed. Ring-tongue terminals shall be Thomas & Betts Stakon.

2.7.4 Terminals shall have insulated ferrules. To assure positive electrical connections, and to avoid damage to the ferrule, it is mandatory that the crimping tool be used in accordance with manufacturer's instructions, and that the proper terminal and crimping tool be used for each wire size. Crimps shall be made with the crimp indentation opposite to the connector seam.

2.7.5 Miscellaneous accessories, such as resistors, fuses, fuse blocks, and capacitors not shown on the Contract Drawings but required for proper operation of the switchgear shall be furnished.

2.7.6 Terminal blocks for current transformer leads shall be 6-point and shall be provided with short-circuiting devices to permit removing or testing of wiring without opening the current transformer circuits. Leads from multi-ratio current transformers shall be brought out to the terminal blocks. Terminal blocks shall be Marathon Series 1600, or as approved by the Owner. Terminal blocks shall be provided for all wires leaving switchboard panels and shall have marking strips for Owner's 6-digit number identification system. Terminal blocks shall have washer head binding screw terminals, barriers between terminals, high flame retarding properties, mechanical toughness and high electrical strength. At least 20% spare terminals shall be provided on each panel. Each wire shall be identified at both ends with a permanently machine-embossed black identification on white plastic, heat-shrinkable, tubular slip-on marker.

2.7.7 Terminal blocks for grouping of SCADA wiring shall be thermo-plastic insulation type, rated 300 Volts, with test socket screws, knife switch contacts and shall be mounted on rails.

The marking system shall be Dekafix consecutive vertical numbering system and

Peso white blanks for Owner's marking. Terminal blocks shall be furnished complete with mounting rails, end brackets, end plates, partitions and test equipment. Wiring to the SCADA terminal blocks shall be made with No. 16 wire minimum.

2.7.8 Wiring Format

a. All terminals shall be numbered, and the numbers shall correspond to the numbers on the wiring diagram.

b. All wires shall be identified at their termination points with the opposite end designation identification by labeled plastic sleeves or equal. Identification shall correspond to the lettered device, numbered terminal format of the wiring diagrams.

2.7.10 System Phase Rotation. The system phase rotation for the island-wide system is GPA C-B-A or NEMA 1-2-3 and all equipment purchased under this contract shall be wired and connected NEMA 1-2-3. All phase markings shall be NEMA 1-2-3. Instrument and relay arrangement shall be 1-2-3 left to right and top to bottom with neutral relays underneath phase grouping. GPA will make the external connections of the incoming and outgoing lines such that GPA C-B-A is connected to NEMA 1-2-3. Phase markings C-B-A shall be reserved for GPA's use.

2.8 NAMEPLATES

Nameplates shall be furnished and installed for panels, switches, relays and devices, including those internally mounted, and shall be of laminated plastic or formica with white letters on black background and shall be sized for easy reading. Nameplates shall be securely fastened to the panel with stainless steel panhead screws to prevent detachment and loss. Nameplate data shall be submitted for Owner's approval. Designations shall be machine engraved in upper case letters and shall be centered on the nameplates. Each metal-clad switchgear unit shall be provided with a circuit identifying nameplate, letters approximately 3/4-inch high, and mounted at the top of the switchgear.

2.9 MIMIC BUS AND DEVICES

Mimic bus shall be 3/8-inch in width and shall be anodized aluminum, approximately 1/16-inch thick, fastened to the panels with adhesive backing or blind metal fasteners. Mimic devices shall be made of the same materials as the bus, and shall indicate the required symbol. The Contractor shall use the Owner’s standard colors as follows:

Yellow	13.8 KV
Red	34.5 KV
Cyan	115 KV

2.10 CONTROL SWITCHES

2.10.1 Control switches shall be the rotary, cam-operated type with silver contacts and a positive means for maintaining contact position. Contact requirements shall be as shown on the Contract Drawings or as specified. Switch contacts shall be totally enclosed to prevent the accumulation of dust, grit, and foreign matter on the contact surface. The switches shall be GE type SB-1, Westinghouse type W-2, Electroswitch Series 24, or equal, and shall have operating handles, as follows:

a. Large red pistol-grip handles for power circuit breaker control switches.

b. Black oval handles with arrow for transfer, and auxiliary switches.

2.10.2 Control switches for circuit breakers shall be momentary contact, spring-return type for both trip and close operation. Operation indicators showing the last operation shall be provided.

2.10.3 The switches shall have escutcheon plates marked as specified with standard circuit designation, except where otherwise specified, and shall be as follows:

a. Escutcheon plate for circuit breaker control switches, 52CS, shall read "TRIP-CLOSE".

b. Escutcheon plate for supervisory selector switch, 43L/R shall be LOCAL-REMOTE.

c. Escutcheon plate for recloser cutout switch, 79CO, shall be CUTIN-CUTOUT.

2.11 INDICATING LIGHTS

Indicating lights shall be the manufacturer's standard transformer type units 125-volt DC input utilizing low-voltage LEDs of the colors indicated: red for breaker close, green for breaker trip, and amber for recloser cutout. Provide indicating lights that are capable of being re-lamped from the switchgear front. Indicating lights utilizing resistors in series with the lamps are not permitted, except in direct-current control circuits. For all breaker control switches and hand reset lockout relays use trip monitors in lieu of standard indicating lights.

2.12 AUXILIARY RELAYS

Control, timing, auxiliary and SCADA interposing and command relays shall operate on 125 VDC. Relay contacts shall have a minimum voltage rating of 480 Volts and a continuous current capacity of not less than 10.0 amperes AC. The contacts shall be field reversible and capable of breaking 20 amperes at 120 VAC and 5 amperes at 125 VDC. Contact arrangement shall be as required for the specified control. The control and auxiliary relays shall be utility grade. Time delay relays shall be Agastat Series 7000.

2.13 SUBSTATION METERING

Power delivery measurement of each power transformer shall be made via Schweitzer Engineering Laboratories' SEL-735, PN 0735VX10944CXXXXXX26101XX .

2.14 TEST SWITCHES AND DEVICES

Current and potential test switches and test plugs shall be provided with the test switches semi-flush mounted on the switchboard. Test switches shall be connected to the appropriate circuits to permit the checking and calibrating of meters, instruments or relays individually against portable standards connected in series with the instruments or relay undergoing tests, under service conditions or by means of a phantom load. The switches and plugs shall permit "in service" testing as well as calibration and checking of instruments, meters and relays from separate sources of power. Provisions shall also be included for connecting current measuring devices in series with the current circuits of the switches. Switch blades shall be separated by insulated barriers and each switch handle shall be provided with a recessed section for inserting circuit identification cards. Switches shall automatically short circuit current transformer circuits so they cannot be opened inadvertently. Current and potential test switches shall be ABB type FT-1.

2.15 TRIP CIRCUIT MONITOR

The trip circuit monitor shall be SEL-2652A, PN: 2652A1XX – red, 125 VDC nominal, 200 ms time delay. The SEL-2652A is a panel-mounted relay that contains a series LED for visual indication and blocking diodes for prevention of alarm indication when the breaker is opened. Trip circuit monitors shall be installed to monitor loss of DC for each circuit breaker and lock-out relay.

2.16 PROTECTIVE RELAYS

2.16.1 General

Protective relays shall be the projection- mounted, back connected, dustproof type, for mounting on a No. 11 United States Standard gauge metal panel. All protective

relays shall be manufactured by Schweitzer Engineering Laboratories. Trip contacts shall be designed for operation on 125 VDC. Each relay shall operate with instrument transformer ratios and connections as shown on the Contract Drawings under both normal and short-circuit conditions. Each overcurrent and differential relay shall provide continuous operation at the current coil tap ratings. Protective relays shall be the type and model indicated below. Substitutions are not acceptable.

2.16.2 Transformer 13.8 kV Main Breaker Overcurrent Protection

The protection for the 13.8 kV main breaker shall be provided by Schweitzer SEL-351-6 (PN 035165A3E54XX2) shall be utilized for both primary and backup protection. The SEL C273A cable for connection to the SEL-3530 communication processor shall be provided.

2.16.3 Feeder 13.8 kV Breaker Overcurrent Protection

The protection for the 13.8 kV feeders shall be provided by Schweitzer SEL-751A relay (PN 751A61ACA1A74850230). Provide multimode fiber optic arc flash detection SEL-C804 point sensors.

Feeder protective relays shall be wired to implement a fast bus protection trip as indicated on the Drawing and as described in Paragraph 2.16.7.

2.16.4 Bus Tie 13.8 Breaker Overcurrent Protection

Primary and backup bus protection relays shall be Schweitzer SEL-351-6 (PN 035165A3E54XX2). The SEL C273A cable for connection to the SEL-3530 communication processor shall be provided.

Bus tie ovecurrent protective relays shall be wired to implement a fast bus protection trip as described in Paragraph 2.16.6.

2.16.5 Communication Processor

The communication processor shall be Schweitzer Type SEL-3530 (PN 35303B0D1313X0XXXXXX) to provide real-time automation control functions in conjunction with the SCADA system specified in Section 16704. The communication processor shall be capable of communicating with other SEL protective relays for control, monitoring, and IRIG-B timing signal interfaces. The communication processor shall include optional input/output Board (24 inputs, 8 output contacts), 10/100 Base-T, HMI, IEC61850, and 17 serial ports. No substitutions allowed.

2.16.6 Fast Bus Protection Trip

Feeder protective relays shall be wired to implement a fast bus protection as indicated on the Drawing. The instantaneous overcurrent element (50) shall provide a hard-wired control input to the transformer low side main breaker protective relay. All control inputs shall be connected in parallel for the main breaker protective relay such that if any of the feeder protection relays asserts it shall block the main breaker from tripping. If the main breaker protective relay asserts and it receives no contact inputs from any of the feeder relays it shall trip immediately to clear the bus. No communication channels shall be necessary to implement the fast bus protection.

2.17 PAINTING

The switchgear enclosure shall be thoroughly cleaned of rust, welding scale and grease, and shall be treated to effectuate a bond between the metal and paint which will prevent the formation of rust under the paint. A priming coat shall be applied immediately after the bonding treatment. A final finish shall consist of not less than one coat for concealed surfaces and two coats for exterior surfaces. Final finish shall be light gray, ANSI Color No. 70. The interior shall be painted with 2 coats of white enamel.

2.18 SPACE HEATERS

1. Equip each section of the switchgear assembly with externally energized space heaters to provide approximately 4 watts per square foot of outer surface area and designed for operation at 120VAC. Locate heaters at the lowest portion of each space to be heated. Cover terminals. Use thermostats to regulate the temperature.

2. Provide heaters that are installed and operable at the time of shipment so that the heaters can be operated immediately upon arrival at the site, during storage, or before installation. Provide connection locations that are marked prominently on drawings and shipping covers and that have temporary leads for storage operation.

2.19 ACCESSORIES AND SPARE PARTS

Accessories, special tools and spare parts required for proper maintenance and testing of the equipment, circuit breakers and devices shall be provided with the switchgear and shall be turned over to GPA upon the completion of the project. Accessories and spare parts shall include the following:

Ten switchboard indicating lamps or LEDs.

One color cap for indicating lamps for each ten or less of each color and type used.

Indicating lamp pullers.

Color caps of each color for indicating lamps.

Twenty control spare fuses of each rating used.

Resistors and lamp sockets for indicating lamps.

Breaker test cabinet, to facilitate operation of a circuit breaker out of its cubicle for test purposes.

Test jumper for testing the breaker when removed from the cubicle.

1 each trip coil for every 4 power circuit breaker provided.

Blank nameplates of each size used.

Gallons of touchup paint in one quart cans.

Closing lever for manual operation.

Levering device for breaker positioning.

Lifting truck for inserting and removing breaker and voltage transformer from switchgear compartment

Turning dolly for handling breaker.

Transport truck for handling breaker outside the cubicle, if required.

Crank for manually charging the stored energy closing mechanism.

Spare fuses for potential transformers.

1,200-Ampere grounding and test device with provisions for independently locking each access door with a padlock without remote control if applicable.

Special tools required for proper maintenance, testing and inspection of the equipment.

Spare vacuum bottle, if applicable.

Test plugs and cables for meters and relays.

2.20 DISCONNECT SWITCHES

2.20.1 Disconnect switches shall be provided as an integral part of the switchgear lineup as shown.

2.20.2 Disconnect switches shall be rated for 15 kV, 1,200A, 3-pole, no-load break, non-fused, manual operation, and shall include a handle interlocked with operating mechanism, viewing window, and auxiliary contacts for future remote indication.

2.21 PACKING AND SHIPPING REQUIREMENTS

2.21.1 Because of severe transportation conditions, the Supplier shall pay particular attention to the proper packaging and bracing of the apparatus to assure its safe arrival.

2.21.2 The Supplier shall prepare all materials and equipment for shipment in such a manner as to protect from damage in transit. All small parts and unit components shall be separately boxed or bundled to prevent galling due to rubbing of one part against another. Each item, box or bundle shall be plainly and individually identifiable for content according to item number, GPA P.O. Number, and Supplier's Identifying Number.

2.21.3 A complete itemized Bill of Lading, which clearly identifies and inventories each assembly, sub-assembly, carton, package, envelope, etc., shall be furnished and enclosed with each item or items at the time of shipment.

2.21.4 The switchgear shall be shipped in crates containing not more than two units each.

PART 3 EXECUTION

3.1 GENERAL

A. Fully assemble switchgear and install in accordance with manufacturer’s instructions.

B. Remove wedges, ties, and shipping blocks.

C. Do not distort frames. Follow manufacturer’s instructions for handling, installing and operating equipment. Ensure personnel working with the equipment fully understand the procedures involved.

D. Make equipment assembly connections between shipping units, including bolted connections to mechanically assemble units and installation of splice plates, bases, and throats, as provided.

E. Make electrical connections between shipping splits per manufacturer’s instructions. Use proper calibrated torque wrench when terminating feeder cables.

F. Make ground connections.

G. Ensure doors and drawout devices are properly aligned and operate smoothly. Correct all misalignment to the Owner's satisfaction.

H. Remove short-circuiting links from current transformers after checking that secondary circuits are complete.

I. Verify that protective relays are properly set according to the relay coordination studies.

3.2 FIELD TESTING AND COMMISSIONING

Refer to Sections 16998 and 16999.

END OF SECTION 16352

SECTION 16353

DISCONNECT SWITCH 34.5 KV

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Requirements for station class hookstick disconnects.

1.02 QUALITY ASSURANCE

A. Factory Inspection and Testing: Assemble, adjust and complete manufacturer's standard production tests in accordance with ANSI C37.30, C37.32 and C37.34.

B. Experience:

1. The manufacturer of each item of equipment or material furnished shall be regularly engaged in the manufacture of the item, and shall have an acceptable history of satisfaction, reliable service in outdoor substation use for a period of at least seven years under comparable environmental conditions.

2. Newly developed equipment with less than seven years actual service will be considered from established manufacturers only if it has been adequately tested, meets the requirements of this specification, and is approved by the ENGINEER.

C. CONTRACTOR's Quality Control Program:

1. The CONTRACTOR shall have a quality program to assure compliance with the requirements of this specification. The program shall be documented and available for the OWNER's review if requested.

2. Documentation of the quality control program shall indicate where in the production and manufacturing process the quality checks are taken, describe the purpose of the checks, and describe the nature of the check; e.g., if check is visual only or if electrical or mechanical testing is used.

1.03 SUBMITTALS

A. Provide the following documents:

1. Catalogs and cut sheets.

2. Single-pole assembly:

   a. Show dimensions from bottom of base to terminal pads at each end.

   b. Dimensions from bottom of base to tip of blade in open position.

   c. Overall length of base and mounting hole locations.

   d. Terminal pad holes relative to base mounting holes.

3. 3-pole arrangement with material list and mounting dimensions.

4. Show weight of complete single-pole assembly.

5. Show weight of complete 3-pole switch assembly, including operating mechanism.

6. Detail drawings of interrupting attachments.

7. Bill of material.

8. Complete installation instructions.

9. Operation, Maintenance, and Installation Manuals

1.04 DEVIATION AND NON-CONFORMANCE REQUIREMENTS

A. Submit for approval and acknowledgement by OWNER all deviations from this specification or changes proposed in materials or design.

B. OWNER may reject materials received with deviations or non-conformances which are not acknowledged as specified above. CONTRACTOR shall be responsible for any corrective action including, but not limited to, materials, labor, and transportation necessary to dispose of, or make the Goods conform to the specification.

C. OWNER will notify CONTRACTOR of defects discovered before or after installation that are believed to be inherent to manufacturing or workmanship. OWNER will describe the item, document the problem, and request disposition and appropriate follow-up measures required from CONTRACTOR.

D. Respond to OWNER's request within thirty (30) days unless an extension is acknowledged and approved in writing by OWNER.

1.05 WARRANTY

A. CONTRACTOR shall warrant the satisfactory and successful operation of the apparatus furnished under this specification at the rating, under the conditions, and for the service specified. CONTRACTOR shall further warrant the apparatus against defects of design, material and workmanship.

1.06 PACKING AND SHIPPING REQUIREMENTS

A. Because of severe transportation conditions, pay particular attention to the proper packaging and bracing of the apparatus to assure its safe arrival.

B. Prepare all materials and equipment for shipment in such a manner as to protect from damage in transit. All small parts and unit components shall be separately boxed or bundled to prevent galling due to rubbing of one part against another. Each item, box, or bundle shall be plainly and individually identifiable for content according to project name, manufacturer, model/serial number, item number, GPA purchase order number, and supplier's identifying number.

C. Furnish and enclose with each item or items at the time of shipment a complete itemized Bill of Lading, which clearly identifies and inventories each assembly, sub-assembly, carton, package, and envelope.

PART 2 - PRODUCTS

2.01 RATINGS

Item	Rating
A. Nominal Voltage	34.5 kV
B. Maximum Voltage	38 kV
C. Continuous Current Rating, Manual Operated	1,200 A
D. Momentary Current Rating	100 kA
E. BIL	200 kV

F. Switch Phase Spacing	48 inches
G. Post Insulator	NEMA TR 231

Each disconnect switch shall be designed and constructed for operation on a 3-phase, 60 hertz, solidly grounded system, at an ambient temperature range from +40 C to -30 C at an altitude below 3,300 feet.

COMPONENTS

A. Switches:

1. Furnish vertical-break configuration, group-operated disconnect switches (with arcing horns) designed for vertical or horizontal mounting.

2. Do not use cast iron for switches.

3. Do not use nonferrous switch parts above the top insulator caps.

4. Use copper, copper alloy, or aluminum alloy for current carrying parts.

5. Furnish a means of adjustment for correction of misalignment in insulators, bases, and operating linkage without removing switch from structure.

6. Provide counter-balanced main switch blades to prevent them from falling closed or open, from any position, in the event of failure in any link of the operating mechanism.

7. Furnish a complete base properly designed for mounting on steel structures. Switch bases shall be steel channel, hot-dip galvanized after fabrication.

8. Space switches at 4 feet phase spacing for 34.5 kV. Provide base mounting for four 5/8 inch mounting bolts spaced on a 9 3/4 x 11 inch pattern per switch.

9. Furnish self-aligning contacts, of high-pressure type of an approved design.

10. Provide self-wiping contacts replaceable in the field without removing the switch from the structure.

11. Furnish flexible leads of suitable ampacity and of noncorrosive material with a clamped and sweated connection for grounding.

B. Insulators: Furnish station post type, ANSI Color No. 70, Light Gray insulators and with a 5 inch bolt circle assembled by the insulator manufacturer.

2.02 SPARE PARTS

A. Furnish spare parts as follows:

	Item	Quantity
1.	Complete insulator stack.	10
2.	Complete set of contacts for 3-phase switch, 1200A.	4

B. Spare parts shall be interchangeable with, and the same material and workmanship as, the corresponding original parts.

C. Package spare parts separately, using moisture-proof packing for protection during shipping and storage. Mark spare parts on the exterior of the package for identification, showing part numbers and descriptions.

END OF SECTION 16353

SECTION 16354

DISCONNECT SWITCH 13.8 KV
(for Switchyard Structure)

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Requirements for station class hookstick disconnects.

1.02 QUALITY ASSURANCE

A. Factory Inspection and Testing: Assemble, adjust and complete manufacturer's standard production tests in accordance with ANSI C37.30, C37.32 and C37.34.

B. Experience:

1. The manufacturer of each item of equipment or material furnished shall be regularly engaged in the manufacture of the item, and shall have an acceptable history of satisfaction, reliable service in outdoor substation use for a period of at least seven years under comparable environmental conditions.

2. Newly developed equipment with less than seven years actual service will be considered from established manufacturers only if it has been adequately tested, meets the requirements of this specification, and is approved by the ENGINEER.

C. CONTRACTOR's Quality Control Program:

1. The CONTRACTOR shall have a quality program to assure compliance with the requirements of this specification. The program shall be documented and available for the OWNER's review if requested.

2. Documentation of the quality control program shall indicate where in the production and manufacturing process the quality checks are taken, describe the purpose of the checks, and describe the nature of the check; e.g., if check is visual only or if electrical or mechanical testing is used.

1.03 SUBMITTALS

A. Provide the following documents:

1. Catalogs and cut sheets.

2. Single-pole assembly:

   a. Show dimensions from bottom of base to terminal pads at each end.

   b. Dimensions from bottom of base to tip of blade in open position.

   c. Overall length of base and mounting hole locations.

   d. Terminal pad holes relative to base mounting holes.

3. 3-pole arrangement with material list and mounting dimensions.

4. Show weight of complete single-pole assembly.

5. Show weight of complete 3-pole switch assembly, including operating mechanism.

6. Detail drawings of interrupting attachments.

7. Bill of material.

8. Complete installation instructions.

9. Operation, Maintenance, and Installation Manuals

1.04 DEVIATION AND NON-CONFORMANCE REQUIREMENTS

A. Submit for approval and acknowledgement by OWNER all deviations from this specification or changes proposed in materials or design.

B. OWNER may reject materials received with deviations or non-conformances which are not acknowledged as specified above. CONTRACTOR shall be responsible for any corrective action including, but not limited to, materials, labor, and transportation necessary to dispose of, or make the Goods conform to the specification.

C. OWNER will notify CONTRACTOR of defects discovered before or after installation that are believed to be inherent to manufacturing or workmanship. OWNER will describe the item, document the problem, and request disposition and appropriate follow-up measures required from CONTRACTOR.

D. Respond to OWNER's request within thirty (30) days unless an extension is acknowledged and approved in writing by OWNER.

1.05 WARRANTY

A. CONTRACTOR shall warrant the satisfactory and successful operation of the apparatus furnished under this specification at the rating, under the conditions, and for the service specified. CONTRACTOR shall further warrant the apparatus against defects of design, material and workmanship.

1.06 PACKING AND SHIPPING REQUIREMENTS

A. Because of severe transportation conditions, pay particular attention to the proper packaging and bracing of the apparatus to assure its safe arrival.

B. Prepare all materials and equipment for shipment in such a manner as to protect from damage in transit. All small parts and unit components shall be separately boxed or bundled to prevent galling due to rubbing of one part against another. Each item, box, or bundle shall be plainly and individually identifiable for content according to project name, manufacturer, model/serial number, item number, GPA purchase order number, and supplier's identifying number.

C. Furnish and enclose with each item or items at the time of shipment a complete itemized Bill of Lading, which clearly identifies and inventories each assembly, sub-assembly, carton, package, and envelope.

PART 2 - PRODUCTS

2.01 RATINGS

Item	Rating
A. Nominal Voltage	14.4 kV
B. Maximum Voltage	15 kV
C. Continuous Current Rating, Manual Operated	2000 A
D. Peak Withstand Amp	114 kA
E. BIL	110 kV

F. Switch Phase Spacing	36 inches
G. Post Insulator	NEMA 225

Each disconnect switch shall be designed and constructed for operation on a 3-phase, 60 hertz, solidly grounded system, at an ambient temperature range from +40 C to -30 C at an altitude below 3,300 feet.

COMPONENTS

A. Switches:

1. Furnish vertical-break configuration, group-operated disconnect switches (with arcing horns) designed for vertical or horizontal mounting.

2. Do not use cast iron for switches.

3. Do not use nonferrous switch parts above the top insulator caps.

4. Use copper, copper alloy, or aluminum alloy for current carrying parts.

5. Furnish a means of adjustment for correction of misalignment in insulators, bases, and operating linkage without removing switch from structure.

6. Provide counter-balanced main switch blades to prevent them from falling closed or open, from any position, in the event of failure in any link of the operating mechanism.

7. Furnish a complete base properly designed for mounting on steel structures. Switch bases shall be steel channel, hot-dip galvanized after fabrication.

8. Space switches at 3 feet phase spacing for 13.8 kV. Provide base mounting for four 5/8 inch mounting bolts spaced on a 9 3/4 x 11 inch pattern per switch.

9. Furnish self-aligning contacts, of high-pressure type of an approved design.

10. Provide self-wiping contacts replaceable in the field without removing the switch from the structure.

11. Furnish flexible leads of suitable ampacity and of noncorrosive material with a clamped and sweated connection for grounding.

B. Insulators: Furnish station post type, ANSI Color No. 70, Light Gray insulators and with a 5 inch bolt circle assembled by the insulator manufacturer.

2.02 SPARE PARTS

A. Furnish spare parts as follows:

	Item	Quantity
1.	Complete insulator stack.	10
2.	Complete set of contacts for 3-phase switch, 2000A.	4

B. Spare parts shall be interchangeable with, and the same material and workmanship as, the corresponding original parts.

C. Package spare parts separately, using moisture-proof packing for protection during shipping and storage. Mark spare parts on the exterior of the package for identification, showing part numbers and descriptions.

END OF SECTION 16354

SECTION 16371

INSULATORS

1.0 GENERAL. Insulators for use on the substation structures and Pole Line construction shall be furnished in accordance with this section and as indicated in GPA Specification No. E-008.

1.1 CODES AND STANDARDS. All insulators furnished under these specifications shall conform to the requirements of the latest applicable standards of ANSI, IEEE, and NEMA.

2.1 PRODUCTS

All material and devices shall be in accordance with the applicable requirements of the Federal "Occupational Safety and Health Standards."

2.1.1 INSULATORS REQUIRED. Furnish insulators in the specified types required to provide a complete installation in accordance with the drawings. The quantity of insulators furnished shall be as indicated on the drawings.

2.1.2 DESIGN REQUIREMENTS. Insulator design requirements are covered in the following paragraphs. Fittings and clamps shall be hot-dip galvanized, malleable iron or bronze. Aluminum fittings and clamps shall not be used.

2.1.3 15 kV DEADEND INSULATOR.

A. The insulator shall be made with polymer EPDM.
B. The end fittings shall be made of forged steel hot dip galvanized for rugged dependability and strength.
C. The chemical bond between rod and weathersheds shall be developed under heat and pressure to give superior dielectric integrity
D. The insulator shall have a solid 5/8 inch epoxy fiberglass rod with a 100,000 psi tensile strength.
E. The surface area shall be of controlled weathering to produce a self-cleaning action to reduce surface contamination and avoid tracking.

Technical Features

1.	kV Rating Phase to Phase	15
2.	Ultimate Tensile Strength Lbs.	15,000
3.	Maximum Design Load Lbs.	7500
4.	Leakage Distance-Ins.	16.5
5.	60 Hz Flashover Dry-Kv	90

6.	60 Hz Flashover Wet-Kv	65
7.	Impulse Flashover Pos.-Kv	140
8.	Impulse Flashover Neg.-Kv	170

Manufacturer

1. Hubbell
2. McLean
3. K-Line

2.1.4 35 kV DEADEND INSULATOR.

A. The insulator shall be made with polymer EPDM.
B. The end fittings shall be made of forged steel hot dip galvanized for rugged dependability and strength.
C. The chemical bond between rod and weathersheds shall be developed under heat and pressure to give superior dielectric integrity
D. The insulator shall have a solid 5/8 inch epoxy fiberglass rod with 100,000 psi tensile strength.
E. The surface area shall be of controlled weathering to produce a self-cleaning action to reduce surface contamination and avoid tracking.

Technical Features

1.	kV Rating Phase to Phase	35
2.	Ultimate Tensile Strength Lbs.	15,737
3.	Maximum Design Load Lbs.	7,869
4.	Leakage Distance-Ins.	37.6
5.	60 Hz Flashover Dry-Kv	170
6.	60 Hz Flashover Wet-Kv	155
7.	Impulse Flashover Pos.-Kv	180
8.	Impulse Flashover Neg.-Kv	290

Manufacturer

1. Hubbell
2. McLean
3. K-Line

2.1.5 35 kV VERTICAL LINE POST INSULATOR.

A. The insulator shall be made of non-tracking EPDM rubber applied by injection molding.
B. The end fittings shall be made of cast iron and hot dip galvanized for corrosion protection.

The fittings shall be joined to the rod by compression process. The pole end fitting shall be for direct mounting. The conductor end fittings shall be of the clamp-top type.

C. The rod shall be of fiberglass reinforced resin.

Technical Features

1.	Maximum Design Cantilever, Lbs.	1350
2.	Maximum Design Tension Lbs.	2800
3.	Leakage Distance, Ins.	36.5
4.	Dry Arcing Distance, Ins.	15.15
5.	Number of Sheds	7
6.	Low Frequency Test Volt, Kv.	22
7.	Maximum Riv. At 1000 Hz Uv Less Than	100
8.	Low Frequency Flashover Dry, Kv	141
9.	Low Frequency Flashover Wet, Kv	122
10.	Critical Impulse Flashover Positive, Kv	239
11.	Critical Impulse Flashover Negative, Kv	309

Manufacturer

1. Hubbell
2. McLean
3. K-Line

END OF SECTION 16371

SECTION 16372

SURGE ARRESTERS

1.0 GENERAL. Surge arresters for outdoor use shall be furnished in accordance with this section and as indicated in GPA Specification No. E-006 and E-018.

1.1 CODES AND STANDARDS. All equipment furnished under these specifications shall conform to the applicable standards of ANSI, IEEE, and NEMA.

All material and devices shall be in accordance with the applicable requirements of the Federal "Occupational Safety and Health Standards."

2.0 PRODUCTS

The surge arresters shall be designed, fabricated, and tested in accordance with ANSI C62.11 and these specifications.

2.1 RATINGS. Surge arresters shall conform to the requirements indicated on the Specification Data Sheets included at the end of this section.

The arresters shall be suitable for operation at the altitude indicated on the Specification Data Sheets included at the end of this section.

2.2 CONSTRUCTION DETAILS. The surge arresters shall be metal oxide type.

The line terminal shall be as indicated on the Specification Data Sheets. The line terminal shall be of sufficient strength to withstand a horizontal load which would develop the full cantilever strength of the insulator.

Surge arresters shall be corona free when energized at the specified maximum operating system voltage.

Surge arresters shall be furnished with all hot-dip galvanized hardware for field mounting on steel supports described in other sections of these specifications.

Porcelain color shall be ANSI 70 light grey.

2.3 MANUFACTURERS. Surge arresters shall be of the manufacturer and type indicated on the Specification Data Sheets included at the end of this section.

2.4 15 kV SURGE ARRESTER SPECIFICATION DATA SHEET

Surge arresters shall be furnished in accordance with the following:
LOCATION AND QUANTITY.

Substation Name

Dededo 34.5 kV Substation

RATINGS

Nominal system voltage, kV (line-to-line)	13.8
Arrester class: ___ Station, _X_ Intermediate	
Maximum continuous operating voltage, kV	12.7
Altitude, ft	3300 ft
Line terminal type: ___ NEMA 4-hole pad, _X_-in. bolt circle	
Porcelain color: _X_ ANSI 70 grey, ___ Brown	
Porcelain minimum creepage distance, inch/kV	1inch/kV

The arresters shall be a nominal 12 KV RMS rating and shall withstand a 60 KV maximum impulse sparkover ANSI front-of-wave. The arresters shall withstand 1.2 x 50 impulse sparkover of 49 KV, and have a minimum 60 HZ sparkover of 22 KV RMS. The maximum discharge voltage (crest KV) at indicated impulse current of 8 x 20 microseconds shall be

38 KV @ 1.5 KA, 46 KV @ 5.0 KA,
52 KV @ 10.0 KA, and 58 KV @ 20.0 KA

MANUFACTURER AND TYPE

ABB/EXLIM
General Electric/TRANQUELL
Ohio Brass/VN

2.5 35 kV SURGE ARRESTER SPECIFICATION DATA SHEET

Surge arresters shall be furnished in accordance with the following:

LOCATION AND QUANTITY.

Substation Name

Dededo 34.5 kV Substation

RATINGS

Nominal system voltage, kV (line-to-line)	34.5
Maximum operating system voltage, kV	38
Arrester class: _X_ Station, ___ Intermediate	
Duty cycle voltage, kV	27
Maximum continuous operating voltage, kV	22
Altitude, ft	3300 ft
Line terminal type: _X_ NEMA 4-hole pad, __-in. bolt circle	
Porcelain color: _X_ ANSI 70 grey, ___ Brown	
Porcelain minimum creepage distance, inch/kV	1inch/kV

The arresters shall be a nominal 30 KV RMS rating and shall withstand a 105 KV maximum impulse sparkover ASA front-of-wave. The arresters shall withstand 1.2 x 50 impulse sparkover of 80 KV, a maximum switching surge sparkover of 85 KV crest and have a minimum 60 HZ sparkover of 54 KV RMS. The maximum discharge voltage (crest KV) at indicated impulse current of 8 x 20 microseconds shall be

77 KV @ 1.5 KA, 90 KV @ 5.0 KA,
100 KV @ 10.0 KA, and 111 KV @ 20.0 KA

MANUFACTURER AND TYPE

ABB/EXLIM
General Electric/TRANQUELL
Ohio Brass/VN

ADDITIONAL REQUIREMENTS

Surge arrester shall be capable of connecting one 4-hole NEMA terminal pad on each side of its terminal pad. Surge arrester shall be suitable for use as bus support.

END OF SECTION 16372

SECTION 16373

TERMINATORS, 15 KV AND 35 KV

1.0 GENERAL. The section covers furnishing of medium voltage terminators. The Contractor shall include furnishing and installing all accessories.

2.1 PRODUCTS

Provide 15 kV and 35 kV terminators with Silicone Polymer Housing. Terminators shall meet or exceed all requirements of IEEE Standard 48 for Class 1 outdoor terminations.

	15 kV Outdoor	35 kV Outdoor
RATINGS		
Voltage Rating (kV)	15	35
Max. Design Voltage to Ground (kV)	9.5	22
Corona Extinction Voltage (kV) (≤3 p.c.) (Partial Discharge)	13	30
Insulation Withstand Voltage:		
Lighting Impulse (BIL Dry 110 Withstand) (kV Crest)	110	200
DC Withstand 15 min. Dry (kV)	75	140
DIMENSIONS		
Number of Sheds	4	8
Minimum Strike Distance	11.6	16.8
Creepage Distance	15.0	30.0

END OF SECTION 16373

SECTION 16390

GROUNDING

3G.1 GENERAL. This section covers the furnishing and installation of grounding materials complete as indicated on the drawings and specified herein.

3G.2 MATERIALS. All grounding materials required shall be furnished new and undamaged in accordance with the following requirements.

Rods	3/4 inch 10 foot copper-clad standard type. The copper-cladding shall be electrolytically bonded to the steel rod or bonded by a molten welding process. Cold rolled copper-cladding is not acceptable. Ground rods shall be as manufactured by Blackburn or Weaver.
Cable Bare	4/0 soft drawn copper grid conductor, Class B stranding, ASTM B8
Bus and bars	Soft copper, cross section not less than 1/8 inch thick by 1 inch wide, ASTM B187
Exothermal welds	Molds, cartridges, materials, and accessories as recommended by the manufacturer of the molds for the items to be welded. Cadweld heavy-duty or acceptable equal. Molds and powder shall be furnished by the same manufacturer.

All clamps, connectors, bolts, washers, nuts, and other hardware used with the grounding system shall be of copper.

3G.3 INSTALLATION. Grounding system materials shall be installed according to the drawings and the requirements which follow.

3G.3.1 Ground Grid. Ground grid conductors under buildings or structures shall be buried with at least 6 inches of earth cover. Buried grounding conductors extending beyond the foundations of buildings or structures shall have at least 18 inches of earth cover.

3G.3.2 Ground Rods. All ground rods shall be located as indicated on the drawings and installed to the depth indicated.

3G.3.3 Conductors. Exposed conductors shall be installed inconspicuously in vertical or horizontal positions on supporting structures. When located on irregular supporting surfaces or equipment, the conductors shall run parallel to or normal to dominant surfaces.

Conductors routed over concrete, steel, or equipment surfaces shall be kept in close contact with those surfaces by using fasteners located at intervals not to exceed 3 feet.

Damaged ground system conductors shall be repaired or replaced by the Contractor as directed by the Owner.

3G.3.4 Connections. All below grade connections shall be made by the exothermal welding process except where otherwise indicated on the drawings or in these specifications. The manufacturer's instructions on the use of exothermal welding materials shall be followed in all details. All surfaces to be joined by the welds shall be thoroughly cleaned. Powder and molds shall be kept dry and warm until used. Worn or damaged molds shall not be used.

All exothermally welded connections shall successfully resist moderate hammer blows. Any connection which fails such test or which, upon inspection, indicates a porous or deformed weld shall be remade.

All exothermal welds shall encompass 100 per cent of the ends of the materials being welded. Welds which do not meet this requirement shall be remade.

Worn, damaged, incorrectly sized, or improperly shaped molds which, in the opinion of the Owner, do not make satisfactory welds shall be removed from the jobsite.

All bolted and screwed connections shall be securely tightened.

3G.3.5 Conduit Grounding. All grounding bushings within all enclosures, including equipment enclosures, shall be wired together and connected internally to the enclosure grounding lug or grounding bus with a bare copper conductor.

Grounding bushings shall be grounded with conductors sized in accordance with NEC, but not smaller than 8 AWG.

All grounding bushings on conduit runs which are terminated at tray shall be connected to the tray grounding cable with bare copper conductor sized as specified above.

Where a conduit run is terminated at tray and the conduit carries a separate grounding conductor, this grounding conductor shall be terminated on the tray grounding cable. If the conduit run is terminated with a grounding bushing and the separate ground conductor it carries is sized in accordance with the requirements of the preceding paragraph for conduit bushing grounding, the

ground conductor in the conduit run shall be continued through the conduit bushing ground connection and terminated on the tray grounding cable making unnecessary the installation of a separate conduit bushing grounding cable.

3G.3.6 Equipment Grounding. All electrical equipment shall be connected to the ground grid with copper grounding conductor. The term "electrical equipment," as used in this article, shall include all enclosures containing electrical connections or bare conductors. Large equipment such as metal-clad switchgear will be furnished with a grounding bus which the Contractor shall connect to the ground grid. Most other equipment will be furnished with grounding pads and/or grounding lugs which the Contractor shall connect to the ground grid. All ground connection surfaces shall be cleaned immediately prior to connection. The Contractor shall furnish all grounding material required but not furnished with the equipment.

Where ground grid extension stingers are indicated on the drawings to be provided for connection to electrical equipment, the Contractor shall connect the bare grounding conductor to the equipment ground bus, pad, or lug. Where a ground conductor is included with the phase conductors of power circuits, the ground conductor shall be connected to the equipment grounding facilities and to the source ground bus. Where a ground conductor is not included with the phase conductors, the equipment shall be grounded by connecting a separate ground cable to the equipment grounding facilities and to the tray ground cable or source ground bus. Except where otherwise indicated on the drawings, all equipment ground conductors which are not an integral part of a cable assembly shall be sized in accordance with the requirements of NEC. All ground conductors installed in conduit shall be insulated.

Suitable grounding facilities, acceptable to the Owner, shall be furnished on electrical equipment not so equipped. The grounding facilities shall consist of compression type terminal connectors bolted to the equipment frame or enclosure and providing a minimum of joint resistance.

The conduit system is not considered to be a grounding conductor except for itself and for lighting fixtures. No grounding conductor shall be smaller in size than 12 AWG unless it is a part of an acceptable cable assembly.

3G.4 GROUND SYSTEM RESISTANCE. All ground resistance measurements shall be made with a three terminal "megger" type ground tester which applies alternating current to the electrodes and which gives a reading in direct current ohms. Two reference ground probes shall be used and all tests shall be made in accordance with the instrument manufacturer's instructions for ground resistance testing. Some of the acceptable instruments are as follows.

Meg and megger ground testers, James G. Biddle and Co.

Vibroground, Associated Research, Inc.

Ground-Ohmer, Herman H. Sticht Co., Inc.

Prior to connection of ground rods to the grounding system, the Contractor shall obtain individual measured ground resistance data from selected ground rods. A minimum of 20 percent of the ground rods shall be tested. This data shall be obtained, identified, and recorded under the supervision of the Owner and records of the results sent to the Owner within 5 days.

After connection of ground rods to the grounding system, the Contractor shall obtain a ground resistance measurement from a selected location on the ground grid. This data shall be obtained, identified, and recorded under the supervision of the Owner and records of the results sent to the Owner within 5 days.

The ground resistance measurement data may indicate that additional ground rods are required. The Contractor shall furnish, install, and connect additional ground rods as the Owner may direct. The Contractor will be reimbursed for the extra work required in accordance with the contract documents.

END OF SECTION 16390

SECTION 16402

INTERIOR WIRING SYSTEMS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods," applies to this section with additions and modifications specified herein.

1.2 SUBMITTALS

1.2.1 Shop Drawings - Submit for the following:

a. Wireway.

1.2.2 Manufacturer's Data:

a. Receptacles;
b. Circuit breakers;
c. Switches;
d. Conduit and fittings (each type);
e. Ground rods;
f. Device plates;
g. Insulated conductors; and
h. Outlet and junction boxes.

1.2.3 Test Reports

Submit test results for approval in report form.

a. 600-volt wiring test.

b. Grounding system test.

1.3 QUALITY ASSURANCE

In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears. Interpret references in these standards to "authority having jurisdiction," or words of similar meaning to mean Engineer.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials, equipment and devices shall, as a minimum, meet the requirements of UL, where UL standards are established for those items, and the requirements of NFPA 70.

2.2 CONDUIT AND FITTINGS

2.2.1 Rigid Steel Conduit (Zinc-Coated)

ANSI C80.1, UL 6.

2.2.2 Rigid Aluminum Conduit

ANSI C80.5, UL 6.

2.2.3 Rigid Nonmetallic Conduit

PVC Type EPC-40, in accordance with NEMA TC2 fiberglass conduit in accordance with NEMA TC14.

2.2.4 Flexible Metal Conduit

UL 1.

2.2.4.1 Liquid-Tight Flexible Metal Conduit (Steel)

UL 360.

2.2.5 Fittings for Metal Conduit, EMT and Flexible Metal Conduit

UL 514B. Ferrous fittings shall be cadmium- or zinc-coated in accordance with UL 514B.

2.2.5.1 Fittings for Rigid Metal Conduit and IMC

Threaded type. Split couplings unacceptable.

2.2.6 Fittings for Rigid Nonmetallic Conduit

NEMA TC3.

2.3 OUTLET BOXES AND COVERS

UL 514A, cadmium- or zinc-coated, if of ferrous metal. UL 514C, if nonmetallic.

2.4 CABINETS, JUNCTION BOXES AND PULL BOXES (WITH VOLUME GREATER THAN 100 CUBIC INCHES)

UL 50, hot-dip zinc-coated, if of sheet steel.

2.5 WIRES AND CABLES

Wires and cables shall meet the applicable requirements of NFPA 70 and UL for the type of insulation, jacket, and conductor specified or indicated. Wires and cables manufactured more than 12 months prior to date of delivery to the site shall not be used.

2.5.1 Conductors

No. 10 AWG and smaller shall be solid; No. 8 AWG and larger shall be stranded. Conductors shall be copper, unless indicated otherwise.

2.5.1.1 Minimum Conductor Sizes

Minimum size for branch circuits shall be No. 12 AWG; for Class 1 remote-control and signal circuits, No. 14 AWG; and for Class 2 Low-energy, remote-control and signal circuits, No. 16 AWG.

2.5.2 Color Coding

Provide for all service, feeder, branch, control, and signaling circuit conductors. Color shall be green for grounding conductors, and white for neutrals, except where neutrals of more than one system are installed in same raceway or box, the other neutral shall be white with a colored (not green) stripe. The color of the ungrounded conductors in different voltage systems shall be as follows:

a. 120/240 volt, single phase: red and black.

2.5.3 Insulation

Unless specified or indicated otherwise or required by NFPA 70, all power and lighting wires shall be 600-volt, Type THW, THWN, XHHW, or RHW, except that grounding wire may be Type TW;

remote-control and signal circuits shall be Type TW, THW or TF. Conductors shall conform to UL 83. Where lighting fixtures require 90 degree C conductors, provide only conductors with 90 degree C insulation or better.

2.5.4 Bonding Conductors

ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.6 SPLICES AND TERMINATION COMPONENTS

UL 486A for wire connectors, and UL 510 for insulating tapes. Connectors for wires No. 10 AWG and smaller diameter wires shall be insulated, pressure-type in accordance with UL 486A or UL 486C (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

2.7 DEVICE PLATES

Provide UL listed, one-piece device plates for outlets and fittings to suit the devices installed. Plates on finished walls shall be urea or phenolic, minimum 0.10-inch wall thickness. Plates shall be the same color as the receptacle or toggle switch with which they are mounted. Screws shall be machine type with countersunk heads in a color to match the finish of the plate. The use of sectional type device plates will not be permitted. Plates installed in wet locations shall be gasketed and UL listed for "wet locations".

2.8 SWITCHES

2.8.1 Toggle Switches

Fed. Spec. W-S-896, totally enclosed with bodies of thermosetting plastic and a mounting strap. Handles shall be ivory. Wiring terminals shall be of the screw type, side wired. Switches shall be rated quiet-type AC only, 120/277 volts, with the current rating and number of poles indicated.

2.8.2 Pilot Lights

Provide yoke-mounted candelabra-base sockets rated 125 volts and fitted with glass or plastic jewels. Provide a clear, 6-watt lamp in each pilot switch. Jewels for use with switches controlling motors shall be green and jewels for other purposes shall be amber.

2.8.3 Disconnect Switches

NEMA KS1. Switches serving as motor-disconnect means shall be horsepower rated. Provide heavy duty type switches where indicated, where switches are rated higher than 240 volts, and for double

throw switches. Fused switches shall utilize Class R fuseholders and fuses, unless indicated otherwise. Provide switches in NEMA enclosure as indicated, per NEMA ICS 6.

2.8.4 Breakers Used as Switches

For 120-Volt fluorescent fixtures, mark breakers "SWD" in accordance with UL 489.

2.9 RECEPTACLES

UL 498 and NEMA WDI, heavy-duty, specification grade grounding type. Ratings and configurations shall be as indicated. Wiring terminals shall be of the screw type, side wired. Connect grounding pole to the mounting strap. Bodies shall be ivory thermosetting plastic supported on a metal mounting strap.

2.9.1 Weatherproof Receptacles

Provide in a cast metal box with a gasketed, weatherproof, cast-metal cover plate and a gasketed cap over each receptacle opening. The caps shall be provided with a spring-hinged flap. Receptacle shall be UL approved for use in "wet locations".

2.9.2 Ground Fault Circuit Interrupter (GFCI) Receptacles

UL 943, duplex type for mounting in a standard outlet box. The device shall be capable of detecting a current leak of 6 milliamperes or greater and tripping per requirements of UL 943 for Class A GFCI devices.

2.10 GROUNDING AND BONDING EQUIPMENT

UL 467. Ground rods shall be copper-encased steel, with minimum diameter of 3/4 inch and minimum length of 10 feet.

2.11 NAMEPLATES

Fed. Spec. L-P-387. Provide as specified in Section 16050, "Basic Electrical Materials and Methods".

2.12 SOURCE QUALITY CONTROL

Test opening around electrical penetrations through fire resistive-rated walls, partitions, floor or ceiling for fire resistive integrity in accordance with ASTM E 814.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to requirements of NFPA 70 and to requirements specified herein.

3.1.1 Wiring Methods

Provide insulated conductors installed in conduit, except where specifically indicated or specified otherwise, or required by NFPA 70 to be installed otherwise. Provide insulated, green equipment grounding conductor in all feeder and branch circuits, including lighting circuits. Grounding conductor shall be separate from electrical system neutral conductor. Provide insulated, green conductor for grounding conductors installed in conduit or raceways. Minimum conduit size shall be 1/2 inch in diameter for low voltage lighting and power circuits. Vertical distribution in multiple story buildings shall be made with metal conduit in fire-rated shafts. Metal conduit shall extend through shafts for minimum distance of 6 inches. Conduit which penetrates fire walls, fire partitions, or floors shall be metallic on both sides of fire walls, fire partitions, or floors for minimum distance of 6 inches.

3.1.1.1 Aluminum Conduit:

Use in exposed installation and in unairconditioned spaces.

a. Do not install underground or encase in concrete.
b. Do not use brass or bronze fittings.

3.1.1.2 Nonmetallic Conduit

Underground Conduit: PVC, Type EPC-40; or fiberglass.

Conduit Embedded in Concrete: PVC, Type EPC-40.

Restrictions applicable to PVC Schedule 40 and PVC Schedule 80:

a. Do not use in areas subject to severe physical damage (including, but not limited to, mechanical equipment rooms, electrical equipment rooms, etc.;
b. Do not use in hazardous areas; and
c. Do not use in penetrating fire-rated walls or partitions, fire rated floors, etc.

3.1.1.3 Rigid Nonmetallic Conduit

a. Restrictions applicable to PVC Schedule 40 and PVC Schedule 80:

(1) Do not use in areas subject to severe physical damage (including, but not limited to, mechanical equipment rooms, electrical equipment rooms, etc.);

(2) Do not use in hazardous areas; and

(3) Do not use in penetrating fire-rated walls or partitions, fire rated floors, etc.

3.1.1.4 Underground Conduit

PVC, Type EPC-40; or fiberglass. Convert nonmetallic conduit other than PVC Schedule 40 or 80, to plastic-coated rigid steel conduit before rising through floor slab; plastic coating shall extend a minimum 6 inches above floor.

3.1.1.5 Conduit Embedded in Concrete

PVC, Type EPC-40.

3.1.1.6 Exposed Conduit

Rigid aluminum conduit.

3.1.2 Conduit Installation

Unless indicated otherwise, conceal conduit within finished walls, ceilings, and floors. Keep conduit minimum 6 inches away from parallel runs of flues and steam or hot-water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project.

3.1.2.1 Where conduits rise through floor slabs, the curved portion of bends shall not be visible above the finish slab.

3.1.2.2 Conduit Support

Support conduit by pipe straps, wall brackets, hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. The load applied to fasteners shall not exceed one-fourth of the proof test load. Fasteners attached to concrete ceiling shall be vibration resistant and shock resistant. Holes cut to a depth of more than 1-1/2 inches in reinforced concrete beams or to a depth of more than 3/4-inch in concrete joints shall not cut the main reinforcing bars. Fill unused holes. In partitions of light steel construction, use sheet-metal screws.

3.1.2.3 Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with a hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of all obstructions.

3.1.2.4 Install pull wires in empty conduit in which wire is to be installed by others. The pull wire shall be plastic having minimum 200-pound tensile strength. Leave a minimum 12 inches of slack at each end of the pull wire.

3.1.2.5 Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use minimum single locknut and bushing. Locknuts shall have sharp edges for digging into the wall of metal enclosures. Install bushings on the ends of conduits and provide insulating type where required by NFPA 70.

3.1.2.6 Stub-Ups

Provide conduits stubbed up through concrete floor for connection to free-standing equipment with an adjustable top or coupling threaded inside for plugs, set flush with the finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 6 inches above the floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.

3.1.2.7 Flexible Connections

Provide flexible connections of short length, 6 feet maximum, for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Provide liquid-tight flexible conduit in wet locations. Provide separate ground conductor across flexible connections.

3.1.3 Boxes, Outlets and Supports

Provide boxes in the wiring or raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be of the cast-metal hub type when located in wet locations, when surface mounted on outside of exterior surfaces, when installed exposed up to 7 feet above interior floors and walkways, or when installed in hazardous areas. Boxes in other locations shall be sheet steel, except that aluminum boxes may be used with aluminum conduit. Each box shall have the volume required by NFPA 70 for the number of conductors enclosed in the box. Boxes for mounting lighting fixtures shall be minimum 4 inches square or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. Boxes for use in masonry-block or tile walls shall be square-cornered tile-type, or

standard boxes having square-cornered tile-type covers. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by the fixture terminal operating temperature; fixtures shall be readily removable for access to the boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of the ceiling supports or make adequate provisions for distributing the load over the ceiling support members. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units and with machine screws or welded studs on steel. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved type fastener maximum 24 inches from the box. When penetrating reinforced-concrete members, avoid cutting any reinforcing steel.

3.1.3.1 Boxes for use with raceway systems shall be minimum 1-1/2 inches deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting-fixture outlets shall be minimum 4 inches square, except that 4 inch by 2 inch boxes may be used where only one raceway enters the outlet. Telephone outlets shall be a minimum of 4 inches square by 1-1/2 inches deep.

3.1.3.2 Pull Boxes

Construct of at least the minimum size required by NFPA 70 of code-gage aluminum or galvanized sheet steel, except where cast-metal boxes are required in locations specified herein. Furnish boxes with screw-fastened covers. Where several feeders pass through a common pull box, tag the feeders to indicate clearly the electrical characteristics, circuit number, and panel designation.

3.1.3.3 Extension Rings

Used only on existing boxes in concealed conduit systems where wall is furred out for new finish.

3.1.4 Mounting Heights

Mount panelboards, circuit breakers, and disconnecting switches so the height of the operating handles at its highest position maximum 72 inches above the floor. Mount lighting switches receptacles and other devices as indicated. Measure mounting heights of wiring devices and outlets to the center of device or outlet.

3.1.5 Conductor Identification

Provide conductor identification within each enclosure where a tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, color coding shall be by factory-applied

color-impregnated insulation. For conductors No. 4 AWG and larger diameter, color coding shall be by plastic-coated self-sticking markers, colored nylon cable ties and plates, or heat-shrink type sleeves. Identify control circuit terminations.

3.1.6 Splices

Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with an insulated pressure type connector. Make splices in conductors No. 8 AWG and larger diameter with a solderless connector and cover with an insulation material equivalent to the conductor insulation.

3.1.7 Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings are not permitted. Plates shall be installed with an alignment tolerance of 1/16 inch. The use of sectional type device plates are not permitted. Plates installed in wet locations shall be gasketed.

3.1.8 Electrical Penetrations

Openings around electrical penetrations through fire resistance rated walls, partitions, floors, or ceilings shall be sealed to maintain fire resistive integrity as tested per ASTM E 814.

3.1.9 Grounding and Bonding

In accordance with NFPA 70. Ground all exposed non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, and neutral conductor of wiring systems. Make ground connection to grounding system. Where ground fault protection is employed, ensure that the connection of ground and neutral does not interfere with the correct operation of the fault protection. Bond building foundation rebars to ground.

3.1.9.1 Grounding Conductor

Provide an insulated, green equipment grounding conductor in all feeder and branch circuits including lighting circuits. Grounding conductor shall be separated from the electrical system neutral conductor. Provide insulated, green conductor for grounding conductors installed in conduit or raceways.

3.1.10 Government-Furnished Equipment

The Contractor shall rough-in for Government-furnished equipment to make equipment operate as intended, including providing miscellaneous items such as plugs, receptacles, wire, cable, conduit, flexible conduit, and outlet boxes or fittings.

3.1.11 Motor Load

When motor size provided differs from the size indicated or specified, make adjustments to the wiring, disconnect devices, and branch circuit protection to accommodate the equipment actually provided.

3.2 FIELD QUALITY CONTROL

Furnish test equipment and personnel and submit written copies of test results to the Engineer. Give five working days notice prior to each test.

3.2.1 Devices Subject to Manual Operation

Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.

3.2.2 Test on 600-Volt Wiring

Test all 600-volt wiring to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on all wiring No. 6 AWG and larger diameter using an instrument which applies a voltage of approximately 500 volts to provide a direct reading of resistance; minimum resistance shall be 250,000 ohms.

3.2.3 Grounding System Test

Test the grounding system to ensure continuity and resistance to ground is not excessive. Test each ground rod for resistance to ground before making any connections to the rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Submit written results of each test to the Engineer and indicate the location of the rods as well as the resistance and soil conditions at the time the measurements were made.

END OF SECTION 16402

SECTION 16405

STATION BATTERIES

1.0 GENERAL. The section covers furnishing of station batteries. The Contractor shall include furnishings and installing all accessories.

2.0 PRODUCTS

A. Station Batteries

Provide station batteries suitable for the requirements of the switchgear and vacuum circuit breakers. Batteries shall be 125 V. Capacity shall be calculated by the switchgear manufacturer and approved by the Contracting Officer before acceptance. Battery calculations for the 34.5 kV switchgear shall also be approved by GPA before acceptance.

B. Construction

a. Each battery cell shall be lead-calcium alloy grid with micro-porous plastic separator construction, and use gelled electrolyte-dryout resistant technology.

b. Cell containers shall be sealed, clear, shock absorbing, heat resistant plastic, explosion proof with pressure relief valves and post seals to eliminate leaking, and certified to IBC 2006 and ASCE 7-05 requirements.

C. Rating

The battery shall be rated in accordance with the following:

Nominal System Voltage		125 Vdc
System Description		2-wire, ungrounded
Minimum Ambient Temperature		40 degrees F
Quantity of Cells		60
Specific Gravity of Electrolyte, Fully Charged, Corrected to 77 degrees F		1.220
Voltage, volts per cell		
Floating		2.20
Final		1.75
Maximum during equalizing or recharging following during discharge		2.33

Ampere Hour Rating		315 (Minimum)

D. Rack

a. Each battery shall be furnished with one two-tier structural steel battery rack, earthquake type per IBC 2006 and ASCE 7-05 Seismic requirements.

b. Before application of paint, all surfaces shall be carefully cleaned of all dirt, moisture, rust, scale, lubricants, and other substances. Lubricants shall be removed by suitable solvents. Rust and scale shall be removed by sandblasting, power sanding, power grinding or power wire brushing.

c. All steel shall have two or more finish coats of acid resistant paint or electrostatically applied epoxy coating finish.

d. Paint films which show sags, checks, blisters, teardrops or fat edges will not be accepted.

e. Battery supporting rails shall be covered with a protective vinyl runner plate not less than 1.58 mm.

E. Accessories

Each battery shall be furnished with the following accessories:

Flame arrester vents
Lead coated intercell connectors to provide not less than 12.7 mm between cells
Lead coated intertier connectors
Connector bolts with acid resistant nuts
Solderless terminal lugs for one 250 MCM copper and one #4 AWG copper cable per polarity
Cell lifting facility
Vinyl coated assembly wrenches
No-Ox-Id grease
One portable acid electrolyte thermometer
One portable acid electrolyte hydrometer syringe
One set of numerals (one numeral per cell) suitable for permanent attachment to cells

END OF SECTION 16405

SECTION 16406

BATTERY CHARGER

1.0 GENERAL. The section covers furnishing of battery charger. The Contractor shall include furnishings and installing all accessories.

2.0 PRODUCTS

BATTERY CHARGER

A. Requirements

1. Battery charger shall be self-regulating, solid-state silicon controlled full have rectifier type designed for single operation with the batteries.

2. The battery charger shall have an input voltage of 240 volt AC, single phase, 60 hertz, 0.75 power factor at full load when tested on battery and resistive load, and 67% efficiency at full load.

3. The battery charger shall maintain an output regulation of less than 0.5% for simultaneous variations of +10/-12% input voltage, +/-5% input frequency, and 0-100% load capacity.

4. Solid-state electronic circuits shall have an ac and dc transient voltage protection. The battery charger shall be designed to recharge a totally discharged battery without overloading and trickle rate charge when the battery is fully charged.

B. Capacity

The battery charger should be able to provide a rated output current capacity of 20 amperes dc continuously at 125 volts dc in an ambient temperature of 104 degrees F (40 degrees C).

C. Construction

The battery charger shall be wall mounted NEMA Type 1 cabinet with a hinged front access door. The enclosure shall be finished painted on the outside and inside with corrosion resistant light gray enamel paint, ANSI Color No. 70, using the manufacturer's standard finish procedure. Cooling system shall not require force ventilation, shall be provided with louvers as required for operation in the specified ambient (except the cabinet top shall be solid).

D. Accessories

Standard features are as follows:

1- DC voltmeter, digital type, 0.5% accuracy
1- DC ammeter, digital type, 0.5% accuracy
1- AC voltmeter, digital type, 2%accuracy
1- Equalize timer, manual reset, 0-100 hours range
2- Potentiometers, one "Float Voltage Adjust" and one "Equalize

Voltage Adjust"
1- DC circuit breaker
1- AC circuit breaker
1- Set of alarm contacts
High and low AC volts
High DC current
High DC volts
Low DC volts
Ground Fault
AC Fail
Charger Failure
1- Set indicating lights LED
1- Ground Detector
1- Lot of nameplates to identify each item mounted on control panel

END OF SECTION 16406

SECTION 16510

LIGHTING SYSTEM

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods", applies to this Section, with the additions and modifications specified herein.

1.2 DESCRIPTION OF WORK

The work includes providing lighting fixtures, photocell switches, dimmer switches, time switches, contactors, and battery-powered units and systems for interior use, including lighting fixtures and accessories mounted on the exterior surfaces of buildings. Materials not normally furnished by manufacturers of these devices are specified in Section 16402, Interior Wiring Systems.

1.3 SUBMITTALS

Data, shop drawings and reports shall employ the terminology, classifications and methods prescribed by the IES Lighting Handbook, as applicable, for the lighting system specified.

1.3.1 Manufacturer's Data

a. Lighting Fixtures, including Lamps and Ballasts
b. Photocell Switch
c. Emergency Lighting Equipment

1.3.2 Shop Drawings

a. Lighting fixture assemblies include computerized horizontal footcandle data at a task plane height of 2.5 feet.
b. Emergency lighting systems.

1.3.3 Certified Test Reports

1.3.3.1 Computerized candlepower distribution data in horizontal plane at angles of every 5 degrees between 0 and 180 degrees, coefficients of utilization, efficiency and distribution class. Testing shall be by an independent testing laboratory. Excerpts of test data on manufacturer's letterhead are not acceptable.

PART 2 PRODUCTS

2.1 FLUORESCENT LIGHTING FIXTURES

UL 1570, except lighting fixtures for damp and wet locations shall conform to UL 57.

2.1.1 Fluorescent Lamps

Provide the number, type and wattage indicated. Provide lamp conforming to ANSI C78.

2.1.2 Fluorescent Ballasts

UL 935, ANSI C82.1 and shall be labeled Certified Ballast Manufacturers (CBM) certified by Electrical Testing Laboratories (ETL).

2.1.2.1 Electronic Ballasts

Provide energy-saving fluorescent ballasts of the CBM certified full light output type. The ballasts shall have an average input wattage of 112 or less when operating four F032T8 lamps, 62 or less when operating two F032T8 lamps, 36 or less when operating one F032T8 lamp, tested in accordance with ANSI C82.2 methods. Ballast shall have a frequency of operation of 20 KHz or greater, and operate without visible flicker. Total Harmonic Distortion shall be less than 20%. Ballast shall meet all applicable ANSI and IEEE standards regarding transient protection. Ballast shall be designed for parallel lamp connection, meaning, if one or more lamps fail, the companion lamps remain fully lit. Ballast shall maintain constant light output over operating range of ± 10% of the input voltage. Ballast factor shall be 0.88 or higher. Nominal power factor shall be 0.95 or higher. Lamp current crest factor shall be below 1.7. Manufacturer shall provide warranty that ballast will be free from defects in material and workmanship for a period of 5 years from the date of manufacture. Warranty shall cover labor and material to replace the defective ballast. Only new ballasts manufactured not earlier than 6 months at time of installation will be accepted. Use single ballast for two or three lamps light fixtures.

a. Acceptable Manufacturers for Fluorescent Electronic Ballast

EBT (Electronic Ballast Technology)
Motorola
Magnetek
Valmont

2.1.3 Open-Tube Fluorescent Fixtures

Provide with spring-loaded telescoping sockets or lamp retainers (two per lamp).

2.2 PHOTOCELL SWITCH

UL 773 or UL 773A, as applicable, hermetically sealed cadmium-sulphide cell rated 120 volts ac, 60 hertz with single-throw contacts rated 1000 watts and 120 volts. Mount switch in a high-impact resistant non-corroding and non-conductive molded plastic housing with a locking-type receptacle. The switch shall turn on below 3 footcandles and off at 3 to 10 footcandles. A time delay shall prevent accidental switching from transient light sources. Mount a directional lens in front of the cell to prevent fixed light sources from creating a turnoff condition. Aim switch according to manufacturer's recommendations.

2.3 EMERGENCY LIGHTING EQUIPMENT

UL 924, NFPA 70, and NFPA 101. Provide lamps in wattage indicated.

2.3.1 Emergency Lighting Unit

Units shall be equipped with brown-out sensitive circuit to activate battery when ac input falls to 75 percent of normal voltage.

PART 3 EXECUTION

3.1 INSTALLATION

Set lighting fixtures plumb, square, and level with ceiling and walls, in alignment with adjacent lighting fixtures, and secure in accordance with manufacturers' directions and approved shop drawings. The installation shall meet with the requirements of NFPA 70. Mounting heights specified or indicated shall be to bottom of fixture for ceiling-mounted fixtures and to center of fixture for wall-mounted fixtures. Obtain approval of the exact mounting for lighting fixtures on the job before installation is commenced and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed.

Light fixtures shall be supported from building main structure. Do not support fixtures by ceiling acoustical panels. Where fixtures of sizes less than the ceiling grid are indicated to be centered in the acoustical panel, support such fixtures independently and with at least two 3/4-inch metal channels spanning, and secured to, the ceiling tees. Provide rods or wires for lighting fixture support under this section of the specifications. Rods or wires shall conform to the requirements of Division 9. Additionally, for recessed fixtures, provide support clips securely fastened to ceiling grid members, a minimum of one at or near each corner of each fixture.

3.1.1 Emergency Lights

Wire emergency lights ahead of the switch to the normal lighting circuit located in the same room or area.

3.2 GROUNDING

Ground noncurrent-carrying parts of equipment as specified in Section 16402, "Interior Wiring Systems". Where the copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

3.3 FIELD TESTS

The Contractor shall provide electric power required for field tests.

3.3.1 Operating Test

Upon completion of the installation, conduct an operating test to show that the equipment operated in accordance with the requirements of this section.

3.3.2 Insulation Resistance Test

Perform as specified in Section 16402, "Interior Wiring Systems", both before and after connection of fixtures and equipment.

3.3.3 Ground Resistance Test

Perform as specified in Section 16402, "Interior Wiring Systems".

3.4 RELAMPING

Relamp luminaires which have failed lamps at completion of work.

3.5 ADJUSTING AND CLEANING

a. Align luminaires and clean lenses and diffusers at completion of work. Clean paint splatters, dirt, and debris from installed luminaires.

b. Touch up luminaire and pole finish at completion of work.

END OF SECTION 16510

SECTION 16704

SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM

PART 1 GENERAL

1.0 SCOPE

1.1. This section includes the requirements for the design, manufacture, factory testing and delivery and installation of indoor supervisory control and data acquisition (SCADA) system. The SCADA system shall be complete and ready for operation with 34.5 kV and 13.8 kV switchgear specified in Section 16351 and Section 16352, respectively. The SCADA equipment shall include the following:

- Central processing unit
- Discrete programmable controller
- HMI Monitor, keyboard and mouse
- GPS Clock
- GPS antenna and accessories
- Full-duplex modems. Two (2) each required
- Fiber optic transceivers
- Cables and connectors
- Circuit breakers and accessory devices
- Cabinet with swing doors

1.2. Zone 4 seismic requirements shall apply. ANSI MC8.1 temperature and humidity requirements shall also apply.

1.2 CONFORMANCE TO STANDARDS AND SPECIFICATIONS

The SCADA system shall meet the requirements of the following standards and specifications, including the latest revisions with respect to material design and tests.

1.2.1 Applicable Standards

Provisions of the following standards shall apply:

IEEE C37.1	Definition, Specification, and Analysis of Systems used for Supervisory Control, Data Acquisition, and Automatic Control
IEEE 999	IEEE Recommended Practice for Master/Remote Supervisory Control and Data Acquisition Communications
NEC	National Electrical Code
NESC	National Electrical Safety Code

1.2.2 Deviation and Non-Conformance Requirements

2.2.1 Deviations from this specification or changes in materials or design after the Purchase Order has been placed must be approved by the GPA Engineering Department and acknowledged by a Purchase Order Amendment.

2.2.2 Units received with deviations or non-conformances which are not acknowledged as specified in Sub-Paragraph 2.2.1 are subject to rejection. The Supplier is responsible for any corrective action including but not limited to materials, labor and transportation necessary to dispose of, or make the units conform to the specification.

2.2.3 Notification of defects discovered before or after installation that are believed to be inherent to manufacturing problems or workmanship shall be made and forwarded to the Supplier. The description of the item, documentation of the problem and the described information, disposition and/or follow-up (as appropriate) that GPA expects from the Supplier will be specified. The Supplier's response shall be made within thirty (30) days unless an extension is acknowledged and approved in writing by the GPA Manager of Engineering.

2.2.4 GPA shall be allowed two (2) weeks to review and approve drawings without affecting the shipping date. Delays in delivery due to drawings which are not approved during this review period are the responsibility of the Supplier.

1.2.3 Warranty

The Supplier shall warrant the satisfactory and successful operation of the apparatus furnished under this specification at the rating, under the conditions, and for the service specified for a period of not less than one (1) year. The Supplier shall further warrant the apparatus against defects of design, material and workmanship.

1.3. SUBMITTALS

1.3.1 Equipment outline drawings shall be submitted for approval within 30 days after Notice to Proceed. The remaining Shop Drawings shall be submitted within 60 days after Notice to Proceed. GPA will provide the successful bidder samples for three line and DC Schematics and preferred format for inter-connection diagrams as a guide.

1.3.2 Shop Drawings and data shall include the following:

a. General arrangement, floor plan, elevations and sections, anchor bolt details, overall dimensions and weights.

b. A complete set of ac and dc schematic diagrams

c. SCADA input and output point list.

c. Panel wiring diagrams with terminal block and device connections. Tabular format is not acceptable.

e. External wiring diagrams with terminal blocks and cables

f. Software and SCADA program descriptions.

g. Bill of materials and manufacturers catalog sheets clearly marked.

h. SCADA HMI screen shots (in color)

i. Operations and maintenance manuals with a section on troubleshooting shall be submitted 30 days prior to shipment.

1.3.3 Instructions for installation shall be submitted within 90 days after Notice to Proceed.

1.3.4 Operations and maintenance manuals with a section on troubleshooting shall be submitted 30 days prior to shipment.

1.3.5 Number of Copies

a. Submit five (5) copies each of shop drawing, pre-printed manufacturers' data, brochures and suppliers' information for review and approval. Electronic copies may be submitted if approved by the Owner.

b. After approval and manufacturing of equipment, submit one (1) reproducible transparency and five (5) prints of each shop drawing which has been specifically prepared for the Work. Indicate on the drawings that the drawings reflect the as-built condition of the equipment.

c. Submit five (5) copies of operations and maintenance manuals with a section on trouble shooting and instructions for installation.

d. Submit one (1) copy of the shop drawings on AUTOCAD 2005 using CD-ROM.

1.4 QUALITY ASSURANCE

1.4.1 Factory Tests

Not less than 30 days prior to factory tests, a factory test plan shall be submitted to the Owner for approval. Each item of electrical equipment and similar equipment supplied as spare parts, shall be given the manufacturer's routine factory tests and also other tests as specified, to ensure successful operation of parts of the assemblies. The factory test equipment and the test methods used shall conform to the applicable requirements of ANSI, IEEE and NEMA standards. Five certified copies of the reports of production tests, including complete test data shall be submitted to the Owner.

1.4.2 Factory Acceptance Test

Not less than 30 days prior to factory tests, a factory test plan shall be submitted to the Owner for approval. Each item of electrical equipment and similar equipment supplied as spare parts, shall be given the manufacturer's routine factory tests and also other tests as specified, to ensure successful operation of parts of the assemblies. The factory test equipment and the test methods used shall conform to the applicable requirements of ANSI, IEEE and NEMA standards. Five certified copies of the reports of production tests, including complete test data shall be submitted to the Owner.

1.4.2.1 Functional Tests

Tests shall be made on assembled SCADA system for proper programming, operations, direction and calibration. Operational tests shall be performed with the SCADA system interconnected with the switchgear equipment specified in Sections 16351 and 16352 to verify monitoring and control capability intended for normal operation.

1.4.2.2 Factory Test Reports

Five (5) copies of certified test results shall be provided to the Owner within 30 days after performance of factory tests.

1.4.3 Field Acceptance Test

Perform field acceptance tests as specified in elsewhere in these specifications.

1.5 TRAINING

1.5.1 Provide a minimum of three (3) day training for SCADA equipment for Owner’s personnel. Training shall consist of classroom and on-site instructions for a minimum of 25 personnel. Supply all necessary reference materials, drawings, and documentation.

1.5.2 Classroom training shall provide a technical overview of SEL-3354 platform, system configuration and communication, screen display (HMI), control and monitoring, alarm processing, input/output points, programming, diagnostics and maintenance requirements.

1.5.3 On-site training shall provide hands-on instructions on SCADA equipment operation in real-time environment. All operating conditions and "what if" scenarios shall be simulated and covered, including remote communications with GPA's energy control system. Interface with protective relays and field equipment shall be reviewed and verified for correct indications and control.

PART 2 PRODUCTS

2.1 GENERAL

The SCADA system shall be housed in a self-standing cabinet and consist of Schweitzer SEL-3354 computing platform, SEL-2440 discrete programmable controller, SEL-2407 GPS clock, interconnecting cables, power strips and breakers as a fully functioning SCADA remote terminal unit that is capable of communicating with the GPA Power Control Center in DNP3.0 protocol. The SCADA system shall be configured for communications with the SEL-2032 communication processors located in the 34.5 kV and 13.8 kV switchgear and retrieve real-time data and engineering data, such as protective relay status, alarms and events access. The SCADA system shall be able to send remote control signals to switchgear line and feeder breakers when the 43L/R switches on the switchgear are in Remote position. Time signals shall be disseminated to all protective relays.

2.2 COMPUTING PLATFORM

The computing platform shall be Schweitzer SEL-3354 (PN 33542M10330H0XXXXX) and shall include SEL-5030 software and Microsoft Windows 7 Ultimate®. SEL-3354 shall be provided with a 17-inch LCD monitor (PN 91610013) with keyboard and mouse (PN 900-0017) and SubstationSERVER.NET v1 configuration's edition, single user license (PN 900-0019). Wiring harness shall be provided.

2.3 GPS CLOCK

The GPS satellite clock shall be Schweitzer SEL-2407 (PN 240700013) with GPS antenna (PN 235-0103). Accessories shall include antenna cable (PN C960, 150 ft), gas tube surge protector (PN 200-2005), mounting brackets (PN 200-2006) and a RG-58 cable with BNC connectors (PN C953).

2.4 DISCRETE PROGRAMMABLE CONTROLLER

The discrete programmable controller shall be Schweitzer SEL-2440 (PN 24402H11A11630). Wiring harness shall be provided.

2.5 SCADA SOFTWARE

The SEL-3354 shall include required sets of client-server for data acquisition from SEL-2032's, communications, event retrieval, relay database access and HMI. Minimally, the following software options shall be provided. Substitution may be allowed if proved equivalent but must be approved by the Owner.

"SubSTATION® Option 2" by Subnet Solutions, Inc.
OPC Client and Server
Port Server
Alarms
Automated File Transfer
DNP Server
Wonderware Intouch® HMI

2.6 SCADA HMI DISPLAYS

The following HMI screens shall be provided as minimum.

Substation One-line Diagram with real-time data
Metering Data (revenue and relay metering)
Main and feeder breaker remote controls
Main and feeder breaker status
Transformer status (provision only)
Protective relay status and alarms
43L/R Switch Status
Alarms with acknowledge-Reset
Alarm History
Setup Menu (password access)

2.7 CABINET AND ACCESSORIES

The cabinet shall be provided with ventilated front and rear lockable doors with ventilating fan on top panel as shown on the Drawing. The front door shall be hinged as shown. The cabinet shall be equipped with a 19-inch relay rack for component mounting, including the HMI monitor, slide-out keyboard tray, and relays. Unused rack spaces shall be covered with blank panels. Circuit breakers and power strips shall be provided for components installed in the cabinet. Wiring and cable management provisions shall be provided for all external cables entering the cabinet. The cabinet shall be approximately 26"W x 32" D x 72" H and constructed of 14 Gage steel. A ground bus shall be provided.

2.8 WIRING AND ACCESSORIES

2.8.1 The SCADA system shall be completely wired at the factory, ready for installation and connection by others. Terminal blocks and jumper cables shall be properly identified for assembly. Unused terminals on relays and auxiliary contacts shall be brought to conveniently located terminal blocks. Cables and all control and meter connections shall enter from the

bottom. The manufacturer shall ensure that sufficient vertical and horizontal clearances are provided for training and terminating these cables without requiring excessive bending or the use of special adapter plates.

2.8.2 All secondary wiring shall be stranded. No. 12 AWG shall be used for control circuits, #10 for CT circuits and #16 for SCADA indication or as indicated in the design drawings. Switchboard wire shall be NEC type SIS, and rated for 600 volts. Insulation jacket shall be gray in color. Splices will not be permitted. Suitable, extra flexible wiring shall be provided over door hinges or other locations where leads may be subjected to flexing.

2.8.3 Ring-tongue terminals shall be used for secondary wiring. Spade, slotted spade, flanged spade, and hook terminals are not acceptable. The strength of the terminals shall be such that the terminals will not break during vibration of the equipment in which the terminals are installed. Ring-tongue terminals shall be Thomas & Betts Stakon.

2.8.4 Terminals shall have insulated ferrules. To assure positive electrical connections, and to avoid damage to the ferrule, it is mandatory that the crimping tool be used in accordance with manufacturer's instructions, and that the proper terminal and crimping tool be used for each wire size. Crimps shall be made with the crimp indentation opposite to the connector seam.

2.8.5 Miscellaneous accessories, such as resistors, fuses, fuse blocks, and capacitors not shown on the Drawings but required for proper operation shall be furnished.

2.8.6 Terminal blocks for grouping of SCADA wiring shall be thermo-plastic insulation type, rated 300 Volts, with test socket screws, knife switch contacts and shall be mounted on rails. The marking system shall be Dekafix consecutive vertical numbering system and Peso white blanks for Owner's marking. Terminal blocks shall be furnished complete with mounting rails, end brackets, end plates, partitions and test equipment. Wiring to the SCADA terminal blocks shall be made with No. 16 wire minimum.

2.8.7 Wiring Format

A. All terminals shall be numbered, and the numbers shall correspond to the numbers on the wiring diagram.

B. All wires shall be identified at their termination points with the opposite end designation identification by labeled plastic sleeves or equal. Identification shall correspond to the lettered device, numbered terminal format of the wiring diagrams.

2.9 NAMEPLATES

Nameplates shall be furnished and installed for panels, switches, relays and devices, including those internally mounted, and shall be of laminated plastic or formica with white letters on black background and shall be sized

for easy reading. Nameplates shall be securely fastened to the panel with stainless steel panhead screws to prevent detachment and loss. Nameplate data shall be submitted for Owner's approval. Designations shall be machine engraved in upper case letters and shall be centered on the nameplates.

2.10 PAINTING

The cabinet shall be thoroughly cleaned of rust, welding scale and grease, and shall be treated to effectuate a bond between the metal and paint which will prevent the formation of rust under the paint. A priming coat shall be applied immediately after the bonding treatment. A final finish shall consist of not less than one coat for concealed surfaces and two coats for exterior surfaces. Final finish shall be light gray, ANSI Color No. 70.

2.11 SPACE HEATERS

Provide heaters that are installed and operable at the time of shipment so that the heaters can be operated immediately upon arrival at the site, during storage, or before installation. Provide connection locations that are marked prominently on drawings and shipping covers and that have temporary leads for storage operation.

2.12 ACCESSORIES AND SPARE PARTS

Accessories, special tools and spare parts required for proper maintenance and testing of the equipment, circuit breakers and devices shall be provided and shall be turned over to GPA upon the completion of the project. Accessories and spare parts shall include the following:

Ten fuses of each rating used.
Four circuit breakers of each type used.
Exhaust fan.
Special tools required for proper maintenance, testing and inspection of the equipment.

2.13 PACKING AND SHIPPING REQUIREMENTS

2.13.1 Because of severe transportation conditions, the Supplier shall pay particular attention to the proper packaging and bracing of the apparatus to assure its safe arrival.

2.13.2 The Supplier shall prepare all materials and equipment for shipment in such a manner as to protect from damage in transit. All small parts and unit components shall be separately boxed or bundled to prevent galling due to rubbing of one part against another. Each item, box or bundle shall be plainly and individually identifiable for content according to item number, GPA P.O. Number, and Supplier's Identifying Number.

2.13.3 A complete itemized Bill of Lading, which clearly identifies and inventories each assembly, sub-assembly, carton, package, envelope, etc., shall be furnished and enclosed with each item or items at the time of shipment.

2.13.4 The SCADA system shall be shipped in crates containing not more than two units each.

PART 3 EXECUTION

3.1 GENERAL

A. Fully assemble and install in accordance with manufacturer's instruction.

B. Remove wedges, ties, and shipping blocks.

C. Do not distort frames. Follow manufacturer's instructions for handling, installing and operating equipment. Ensure personnel working with the equipment fully understand the procedures involved.

D. Make all electrical connections. Use proper calibrated torque wrench when terminating feeder cables.

E. Make ground connections.

3.2 FIELD TESTING AND COMMISSIONING

Submit test and commissioning procedures for field testing and acceptance of the SCADA system in accordance with the manufacturer's recommendations, for approval by the Owner. Procedures shall include steps to verify data acquisition and controls between protective relays and SEL-3354, and steps to verify and confirm communications with the remote terminal unit for data acquisition and controls. Accuracies of acquired data shall be verified against calibrated test equipment.

Refer to Section 16998 and 16999 for other field installation testing and startup requirements.

END OF SECTION 16704

SECTION 16802

CONDUCTORS

3F.1 GENERAL. Insulated cable, conductors, and conductor accessories shall be furnished and installed in accordance with the requirements of this section of these specifications. Insulated cable, conductors, and conductor accessories shall be furnished in quantities sufficient for a complete installation as indicated in the control and relay manufacturer's circuit list, on the drawings, and in these specifications.

Cable reels shall be stored and handled in a manner which will prevent physical damage to the cable. Cable reels shall be stored on a hard surface to prevent contact between cable insulation and earth due to sinking of the reel. Impact damage between reels shall be prevented by aligning reels flange to flange or by using guards across flanges. During storage, the ends of all cable rated 5 kV and above shall be protected with end caps.

Installation shall be defined to include placement, splicing, terminating conductors, coiling and taping of spare conductors, identification, testing, and verification of each circuit, cable, and conductor.

Terminating a conductor shall include installing cable termination kits for shielded cable, attaching the conductor at its designated location, and insulating the entire connection where specified or required by the application.

3F.2 CABLE SPECIFICATIONS. The cable furnished shall conform to the Cable Type Listing included at the end of this section.

The term "Type" used in the Cable List, on the drawings, and in these specifications refers to the letter identification indicated on the Cable Type Listing.

3F.2.1 Cable Manufacturers. The cable furnished shall be produced by one or more of the manufacturers indicated in the following tables or by the manufacturers indicated on the Cable Type Listing. Each "X" in the tables indicates an acceptable manufacturer of the indicated cable.

NONFLAME RETARDANT CABLE

	Power Cable 5 kV & Above	Ltg & 600 V Power Cable	Control Cable	Instru Cable	Thermo-couple Exten Cable	High Temp Cable
BIW Cable Systems, Inc.		X	X	X	X	
Cablec Corp.	X	X	X	X	X	
Fluorocarbon DeKoron			X	X	X	
The Okonite Co .	X	X	X	X	X	X
Pirelli Cable Corp.	X	X	X			
Tamaqua Cable Products Corp.		X	X			
The Rockbestos Co.		X	X	X	X	X
Rome Cable Corp	X	X	X	X		
Thermo Electric				X	X	X

FLAME RETARDANT CABLE

	Ltg & 600 V Power Cable	Instrument Cable
BIW Cable Systems, Inc.	X	X
Cablec Corp.	X	X
Delta Surprenant Wire & Cable	X	X
The Okonite Co.	X	X
Pirelli Cable Corp.	X	
Tamaqua Cable Products Corp.	X	
The Rockbestos Co.	X	X
Rome Cable Corp.	X	X

A durable marking shall be provided on the surface of the cable at intervals not exceeding 24 inches. Markings shall include manufacturer's name, insulating material, conductor size, and voltage class.

3F.2.2 Test Reports. Unless otherwise specified, the Contractor shall submit three copies of manufacturers' test reports on each cable to the Owner.

3F.3 CONDUCTOR ACCESSORIES. All conductor accessories including connectors, terminations, insulating materials, support grips, markers, and cable ties shall be furnished and installed.

Supplier's installation instructions shall be obtained for cable accessories. These instructions shall be in the possession of the craftsmen while installing the accessories and shall be available to the Owner for reference.

3F.3.1 Terminal Connectors for Conductors 8 AWG and Larger. Terminal connectors for conductors 8 AWG and larger shall be pressure or bolted clamp type, Burndy Qiklug, Varilug, or acceptable equal; or compression type, Burndy Type YAV or YA (long barrel), Panduit Type LCA or LCC, or acceptable equal.

3F.3.2 Terminal Connectors for Conductors Smaller than 8 AWG. Terminal connectors for conductors smaller than 8 AWG shall be compression type connectors properly sized for the conductor and the terminal. The connectors shall be constructed of fine grade high conductivity copper in accordance with QQ-C-576 and shall be tin plated in accordance with MIL-T-10727. The interior surface of the connector wire barrel shall be serrated, and the exterior surface of the connector wire barrel shall be provided with crimp guides.

Noninsulated terminal connectors shall be provided on conductors terminated on devices equipped with individual fitted covers, such as General Electric Type SB- l control switches and General Electric Type HEA lockout relays. Preinsulated ring type terminal connectors shall be used on all current and potential transformer circuits. All other terminal connectors for conductors smaller than 8 AWG shall be preinsulated ring type.

Preinsulated terminal connectors shall include a vinyl insulating sleeve, color coded to indicate conductor size. Preinsulated terminal connectors shall include a metallic support sleeve bonded to the vinyl insulating sleeve and designed to grip the conductor insulation.

Ring type connectors shall be manufactured by AMP, 3M, Panduit, or acceptable equal.

3F.3.3 Terminal Blocks. Terminal blocks for conductors rated 600 volts or less shall be strap screw type, rated 600 volts, shall have 25 percent more terminal points than the quantity of conductors requiring termination, and shall have white marking strips. Terminal blocks shall be sized for the conductor being terminated except that terminal blocks for all conductors 10 AWG and smaller shall be Marathon 1500 Series or acceptable equal.

3F.3.4 Splicing Connectors. Splices in conductors other than lighting conductors shall be with compression type connectors. Splices in lighting conductors smaller than 8 AWG shall be with 3M Company "Scotchlok" twist type insulated spring connectors, Panduit JN wire joints, or acceptable equal. Splices in lighting conductors 8 AWG and larger shall be with compression type connectors.

3F.3.5 Crimping Tools. Crimping tools used to secure conductors in compression type connectors or terminal lugs shall be those made for that purpose and for the conductor sizes involved. The crimping tools shall accurately crimp the connector barrel and shall accurately crimp the conductor insulation support sleeve where provided. Crimping tools shall be provided with guides to position connectors in the tool, shall be provided with stops to prevent overcrimping, and shall be of a type which prevents the tools from opening until the crimp action is completed. Crimping tools shall be a product of the connector manufacturer or shall be as recommended by the connector manufacturer and acceptable to the Owner for use with the connectors. The Contractor shall establish and maintain a tool certification program to ensure that crimping tools are kept in accurate operating condition.

3F.3.6 Insulating Materials. Insulating materials for splice and termination insulation shall be in

accordance with the following.

3F.3.6.1 600 Volt Cable. Insulating materials for terminal connectors or compression type splicing connectors shall consist of varnished cambric tape, rubber tape, and vinyl tape. Taping materials shall be as listed below or acceptable equal.

Varnished Cambric Tape - 3M Company Irvington 2520
Rubber Tape - 3M Company Scotch 130C
Vinyl Tape - 3M Company Scotch 33+

3F.3.6.2 Shielded Cable Rated 5 kV and Above. Splicing connectors for 5 kV and 15 kV cable shall be insulated using 3M Company 5400 Series Quick-Splice Inline Splicing Kits, Raychem Type HVS splicing kits, or acceptable equal.

Connections to insulated switchgear buses shall be insulated with removable boots furnished with the switchgear or acceptable equal.

Other indoor terminal connectors, including those located in air insulated terminal chambers, shall be insulated using Raychem Type HVBC high voltage bus connection kits or be insulated by utilizing a taped system. Taping materials shall be as listed below or acceptable equal.

Copper Braid Tape	-	3M Company Scotch 24
Rubber Tape	-	3M Company Scotch 130C
Vinyl Tape	-	3M Company Scotch 33+

3F.3.7 Support Grips. Cable support grips shall be either split or closed woven wire type as manufactured by The Kellems Division, Harvey Hubbell Incorporated, Stonington, Connecticut.

3F.3.8 Wire and Cable Markers. Markers for wire and cable circuits shall be of an opaque nylon material arranged to include a marker board, nonreleasing holding device, and cable fastening tail. The marker board shall not be less than 3/4 inch wide, 2-1/2 inches long, and 15 mils thick and shall be Panduit Corp. Part No. MP250 marker plates or acceptable equal. One side shall be roughened to hold black nylon marking ink from a fine tip pen similar to Thomas & Betts Company "TY-RAP" marking pen, Catalog No. WTl63M-l, or Panduit Corp. Part No. PFX-0 marking pen. Identification shall be permanent and waterproof. The holding device shall be designed to allow the fastening tail to pass around the cable through the holding device and prevent the removal of the tail without cutting it loose from the marker.

3F.3.9 Cable Ties. Lacing materials for field installed cable shall be nonreleasing weather-resistant black nylon ties manufactured by Thomas & Betts Company, Elizabeth, New Jersey; Panduit Corp., Tinley Park, Illinois; 3M Company; or acceptable equal.

3F.3.10 Cable Termination Kits for Shielded Cable Rated 5 kV and Above. All cable termination kits for shielded cable rated 5 kV and above shall be in accordance with the requirements of IEEE 48 for Class 1 terminations.

Cable termination kits for 5 kV and 15 kV shielded cable shall be 3M Company Quick-Term molded rubber termination kits which include stress cones and insulators, 3M QuickTerm III cold shrink termination kits, or acceptable equal.

3F.4 INSTALLATION. Conductor installation shall be in accordance with the cable manufacturer's recommendations and the articles which follow.

3F.4.1 Cable Placement. All cable described in the Circuit List shall be routed as indicated therein. Routing of other cable shall be as indicated on the drawings.

Cable shall not be handled when the cable temperature is below the minimum temperature recommended by the manufacturer. If cable heating is required prior to placement, the cable shall be stored in a heated building in accordance with the manufacturer's recommendations for at least 24 hours. Cable shall be placed the same day it is removed from heated storage.

If at any time during the progress of the work the Contractor finds raceways which appear inadequate to accommodate the assigned cable, he shall notify the Owner at once and shall discontinue any further work on the questionable raceway until advised by the Owner as to how he shall proceed.

Immediately prior to the placement of each cable or cable group in its assigned raceway, the dimensions of the cable and raceway shall be checked to determine that the raceway is of adequate size according to the requirements of NFPA No. 70 (NEC) for new raceway. If the raceway size is inadequate, a new raceway of sufficient capacity shall be provided.

Immediately prior to the placement of each cable or cable group, the raceway route to be followed shall be inspected and ascertained to be complete in installation and free of all materials detrimental to the cable or its placement. All cable assigned to a particular duct or conduit shall be grouped and pulled in simultaneously using cable grips and acceptable lubricants.

All cable shall be carefully checked both as to size and length before being pulled into conduits or ducts. Cable pulled into the wrong conduit or duct or cut too short to rack, train, and splice as specified herein shall be removed and replaced by and at the expense of the Contractor. Cable removed from one conduit or duct shall not be pulled into another conduit or duct.

Conductors in parallel shall:

a) Be the same length

b) Consist of the same conductor material
c) Be the same size in circular mil area
d) Have the same insulation type
e) Be terminated in the same manner

3F.4.1.1 Cable in Manholes. Cable shall be supported at all times without short bends or excessive sags. Cable ends must not be submerged. Cable racks or trays shall be provided for permanent support. Temporary support required during placement shall be with rope slings, timbers, or alternate method acceptable to the Owner.

3F.4.1.2 Cable Pulling. Fishing and pulling shall be done with flexible round metal tape, CO_2 propelled polyethylene cord, nylon rope, or manila rope.

Unless specified otherwise or acceptable to the Owner, cable shall not be pulled in a single pull through two sections of Owner-designed raceway connected by a manhole. Cable shall be pulled out at each manhole to the length required for termination. Prior to repulling of the pulled out cable, the cable shall be thoroughly inspected, cleaned, and relubricated. Damaged cable shall be removed and replaced by and at the expense of the Contractor.

3F.4.1.3 Cable Grips. Factory installed pulling eyes shall be used for pulling cable where they are available. Woven wire cable grips shall be used to pull all single conductor cable 2/0 AWG and larger, where pulling eyes are not available, and all multi-conductor cable. Pulling loops shall be used to pull single conductor cable smaller than 2/0 AWG. All sharp points and edges on the hardware attaching the pulling rope to the cable shall be taped to prevent snagging or damaging the raceway.

When a cable grip or pulling eye is used for pulling, the area of the cable covered by the grip or seal plus 6 inches shall be cut off and discarded when the pull is completed. When pulling loops are used, the entire loop shall be cut off and discarded when the pull is completed.

As soon as the cable is pulled into place, the pulling eyes, cable grips, or pulling loops shall be removed and any cable which was sealed shall be resealed.

3F.4.1.4 Swivels. A reliable nonfreezing type of swivel, or swivel connection, shall be inserted between the pulling rope and the cable pulling eye, grip, or loop to prevent twisting under strain.

3F.4.1.5 Pulling Lubricants. Only lubricants recommended by the cable manufacturer and acceptable to the Owner shall be used. Lubricants shall be applied liberally and continuously during the pull.

3F.4.1.6 Inspection. The outside of each cable reel shall be carefully inspected and protruding nails, fastenings, or other objects which might damage the cable shall be removed. A thorough

visual inspection for flaws, breaks, or abrasions in the cable sheath shall be made as the cable leaves the reel, and the pulling speed shall be slow enough to permit this inspection. Damage to the sheath or finish of the cable shall be sufficient cause for rejecting the cable. Cable damaged in any way during installation shall be replaced by and at the expense of the Contractor.

3F.4.1.7 Pulling Tension. The pulling tension of any cable shall not exceed the maximum tension recommended by the cable manufacturer. Pulling mechanisms of both the manual and power types used by the Contractor shall have the rated capacity in tons clearly marked on the mechanism. Whenever the capacity of the pulling mechanism exceeds the recommended pulling tension of the cable as given by the cable manufacturer, a dynamometer shall be used to show the tension on the cable and the indicator shall be constantly watched. If any excessive strain develops, the pulling operation shall be stopped at once and the difficulty determined and corrected.

3F.4.1.8 Sidewall Pressure. To avoid insulation damage from excessive sidewall pressure at bends, the pulling tension in pounds at a bend shall not exceed 300 times the radius of the bend in feet.

3F.4.1.9 Cable Bends. Tape shielded, flat tape armored, and wire armored cable shall not be bent to a radius of less than 12 times the overall cable diameter. All other cables shall not be bent to a radius of less than eight times the cable diameter.

3F.4.1.10 Supports. All cable supports and securing devices shall have bearing surfaces located parallel to the surfaces of the cable sheath and shall be installed to provide adequate support without deformation of the cable jackets or insulation.

Adequate cable end lengths shall be provided and properly placed in manholes to avoid longitudinal strains and distorting pressures on the cable at conduit bushings and duct end bells.

Final inspection shall be made after all cable is in place and, where supports or raceway fittings deform the cable jacket, additional supports shall be provided as directed by the Owner. Additional cable protection such as a wrapping of light rubber belting, friction tape, or similar material shall be provided where required.
Cable in vertical runs shall be supported by woven wire grips in accordance with the NEC requirements, except that the distance between supports shall conform to the following.

	Vertical Cable Support Spacing	
Conductor Size	Aluminum Conductor	Copper Conductor
1/0 AWG and smaller	150 feet	100 feet
2/0 AWG thru 500 MCM	100 feet	50 feet
Larger than 500 MCM	70 feet	30 feet

3F.4.1.11 Cable Racks. Where cable trays are not specified in manholes, cable racks shall be furnished and installed as required to provide the proper cable support. Cable racks shall be installed on spacings of not greater than 36 inches and shall be bolt secured to permanent wall surfaces with self-drilling anchors.

3F.4.1.12 Spare Conductors. All spare conductors of a multi-conductor cable shall be left at their maximum lengths for possible replacement of any other conductors in the cable. Each spare conductor shall be neatly coiled and then taped to the conductors being used.
3F.4.1.13 Lacing. Nylon ties shall be used to neatly lace together conductors entering switchboards and similar locations after the conductors have emerged from their supporting raceway and before they are attached to terminals.

3F.4.1.14 Cable Identification. The Contractor shall identify the ends of all circuits listed in the Circuit List. The Contractor shall also identify all circuits in manholes and pull boxes.

Each marker shall bear the number of the circuit according to the Circuit List and drawings.

At terminations, the Contractor shall identify each conductor of power circuits, each multi-conductor cable, and each conductor of circuits consisting of multiple single conductors where the conductors are not otherwise identified. Markers shall be attached where the first individual conductor is routed away from the assembly. Each phase of multiphase power circuits shall be individually identified.

One end of each marker board shall remain free of the fastening tail, and the entire marker shall be so attached that it is readily visible for circuit identification.

3F.4.1.15 Moisture Seals. Each cable rated 5000 volts and above shall be kept sealed except when termination and splicing work is being performed.

The ends of all cables shall be sealed with heat shrinkable caps. Cap sizes shall be as recommended by the cap manufacturer for the cable OD and insulation. Caps shall contain sufficient adhesive that shrinkage of the cap during application results in formation of a positive watertight seal capable of withstanding complete immersion or total exposure without permitting the entrance of moisture. Heat shrinkable caps shall be "Thermofit" as manufactured by Raychem Corporation or acceptable equal.

Before and after pulling, the leading end seal of each length of cable shall be examined and repaired if necessary. All cut cable ends shall be promptly sealed after cutting except those to be spliced or terminated immediately.

3F.4.1.16 Cable Arcproofing. All nonflame retardant cable rated 5 kV and above shall be arcproofed where it occupies an enclosure such as a pull box, manhole, or "tray-to-duct" transition box.

The separate conductors of a single circuit may be grouped together under the arcproof covering if they are pulled into a single duct. Single conductors pulled into single ducts shall be individually arcproofed.

Arcproofing shall extend in one helically wound half-lapped layer throughout the entire length of cable occupying the box or manhole. The arcproofing shall be secured in position with glass tape random wrapped according to the instructions of the arcproofing tape manufacturer.
Cable identification shall be located over the arcproofing tapes.

3F.4.2 Splices. No splices shall be made in conductors for instrument circuits or control circuits without specific acceptance by the Owner except where required at connections to accessory devices equipped with factory installed pigtails or where high temperature wire is necessary locally to connect to a particular device. Shields may be spliced where necessary to permit connection to the station ground.

Power cable circuits may be spliced only by methods and at locations acceptable to the Owner.

Splices shall not be made to utilize short lengths of cable nor shall they be made to provide correct lengths on cable initially cut too short for a particular circuit.

Splices, joints, and connections in cable shall be made only in pull boxes, junction boxes, or manholes unless otherwise indicated on the drawings and shall be made in accordance with the instructions of the cable manufacturer.

Splices in cable shall be prepared and insulated in a manner similar to the cable terminations specified below.

3F.4.3 Terminations. Cable shall be terminated in accordance with the following requirements.

Train cable in place and cut squarely to required length. Avoid sharp bends.

Remove necessary amount of cable jacket and insulation without damage to the conductor.

Install terminals or terminal connectors as required, ensuring a firm metal-to-metal contact.

Install high voltage cable termination kits for shielded cable rated 5 kV and above using the procedures recommended by the manufacturer of the kit being used.

Insulate each connection of cable to an insulated conductor (whether cable, bus, or

equipment bushing). The insulation shall cover all exposed surfaces of the conductors; the insulation voltage level of the completed termination shall be not less than the insulation voltage level of the connected conductors.

3F.4.3.1 Insulation of 600 Volt Cable Connections. Where connections of cable rated 600 volts or less require insulation, all exposed conductor and connector surfaces shall be covered with tape in accordance with the following.

One half-lapped layer of varnished cambric tape

A minimum of three half-lapped layers of rubber tape, elongated not more than 20 percent, applied over the varnished cambric tape

A minimum of three half-lapped layers of vinyl tape applied over the rubber tape. The vinyl tape shall extend a minimum of two cable diameters over the cable jacket and a similar distance over the insulation of the conductor to which the cable is connected.

3F.4.3.2 Insulation of Connections on Indoor Shielded Cable Rated 5 kV and Above. Where indoor connections of shielded cable rated 5 kV and above require insulation, the connections shall be insulated using removable boots or connection kits or shall be taped in accordance with the following.

All exposed conductor and connector surfaces shall be covered with one half-lapped layer of copper braid tape.

Half-lapped layers of rubber tape, elongated not more than 20 percent, shall be applied over the copper tape. The number of layers of this tape shall be in accordance with the following.

Line-to-Line Operating Voltage of Equipment	Number of Half-Lapped Layers of Rubber Tape Required
2,400	4
4,160	5
6,900	7
13,200	10

Two half-lapped layers of vinyl tape shall be applied over the rubber tape. The tape shall extend a minimum of two cable diameters over the cable jacket and a similar distance over the insulation of the conductor to which the cable is connected.

3F.4.4 Tests After Placement. All insulated conductors shall be electrically tested after placement.

All circuits, including lighting circuits, shall be tested with the circuit complete except for connections to equipment. All splices, stress cones on shielded cable, and terminal connector attachments shall be complete prior to testing.

Any circuit failing to test satisfactorily shall be replaced or repaired and then retested.

All equipment and labor required for testing shall be furnished by the Contractor.
3F.4.4.1 Continuity and Identification Tests. All insulated conductors shall be tested for continuity and conductor identification.

3F.4.4.1.1 Continuity Tests. Continuity tests shall include all tests necessary to confirm that each conductor is continuous throughout its entire length.

3F.4.4.1.2 Identification Tests. Identification tests shall include all tests necessary to confirm that the conductor being investigated originates and terminates at the locations designated in the Circuit List or indicated on the drawings.

3F.4.4.2 Insulation Tests. Resistance from ground provided by the insulation on all field installed insulated conductors shall be measured.

3F.4.4.2.1 Cable Rated 5000 Volts and Above. All conductors with insulation rated 5000 volts and above shall be given a field voltage test.

The ampacity of direct current testing equipment shall be not less than 2,500 microamperes.

Application of test voltage shall be as specified on the Cable Test Data form included at the end of this section. Final test voltage and the duration of the test shall be as indicated on the Cable Type Listing for the cable under test.

The tests shall be performed by competent personnel specializing in electrical cable testing. Cable test data on each cable tested shall be reported to the Owner in triplicate on Cable Test Data forms provided by the Owner.

3F.4.4.2.2 Cable Rated Below 5000 Volts. All insulated conductors, except supervisory and communication cable, rated less than 5000 volts shall be tested with a 1000 volt megger or an equivalent testing device. Insulation resistance measurements shall be made between each conductor and ground and between each conductor and all other conductors of the same circuit. Minimum acceptable resistance values shall be approximately 500 megohms.

CABLE TYPE LISTING

Cable Type	Description
A	600 volts, single copper conductor, Class B stranded, power cable, EPR insulation, chlorosulfonated polyethylene jacket. Cable shall be UL listed as Type USE or RHH or RHW and VW-1, and shall be Cablec Durasheath EP. (10 AWG through 500 MCM)
B	600 volts, multi-conductor, 10 and 12 AWG control cable, Class B stranded copper conductors, flame retardant, cross-linked polyethylene insulation, flame retardant PVC overall jacket, and with ICEA S-66-524, Method 1 (K-2) conductor identification; black, red, blue, orange, yellow, brown, etc. Conductors shall be taped with white or green tape to indicate a neutral or grounded conductor. Cable is available from stock as Houston Wire and Cable Catalog No. 241001202 through 241001212 (2 through 12 conductor 12 AWG) and Catalog No. 241001002 through 241001004 (2 through 4 conductor 10 AWG).
C	300 volts, single pair instrument cable, twisted pair, tinned copper drain wire, 16 AWG, Class B stranded copper conductors, flame retardant PVC insulation with overall flame retardant PVC jacket. Cable shall be capable of passing the UL 70,000 Btu flame test.
D	300 volts, twelve pair instrument cable, twisted pair, tinner copper drain wire, 19 AWG, Class B stranded copper conductors, flame retardant PVC insulation with overall flame retardant PVC jacket.
RHH	600 volts, single conductor, lighting cable, Class B stranded, copper conductors, and flame retardant cross-linked thermosetting polyethylene insulation with ICEA S-66-524 Method 1, Table K-1 conductor identification, colored compounds with tracers.
SF-2	600 volts, single copper conductor, stranded, 12 AWG, lighting fixture and high temperature control wire, silicone rubber insulation, glass braid jacket. Cable shall be UL listed as Type SF-2.
SIS	600 volts, single copper conductor, stranded, switchboard wire. Cable shall be UL listed as Type SIS.

END OF SECTION 16802

SECTION 16803

35 kV 1000 KCMIL ALUMINUM UNDERGROUND CONDUCTOR, TERMINATORS, AND ACCESSORIES

1.0 GENERAL. The section covers furnishing of underground 35 kV 1000 kcmil Aluminum underground conductor as indicated in GPA Specification No. E-045. The Contractor shall include furnishing of terminators and accessories to be installed at both ends of the cable.

2.1 PRODUCTS

35 KV UNDERGROUND CONDUCTOR, TERMINATORS, AND ACCESSORIES

A. 1000 kcmil Aluminum cable, 35 kV, XLPE-TR, 133% insulation, HDPE jacket
B. Termination kits, Cold Shrink, 3M Catalog No. 5648 for use indoors and outdoors
C. Accessories
    1. Lugs 1000 kcmil cable, 3M 31000 Series
    2. Mounting Brackets for 1000 kcmil cable, 3M Catalog No. MBS-6

END OF SECTION 16803

SECTION 16804

15 KV 750 KCMIL COPPER UNDERGROUND CONDUCTOR, TERMINATORS, AND ACCESSORIES

1.0 GENERAL. The section covers furnishing of underground 15 kV 750 kcmil Copper underground conductor as indicated in GPA Specification No. E-033. The Contractor shall include furnishing of terminators and accessories to be installed at both ends of the cable.

2.1 PRODUCTS

15 KV UNDERGROUND CONDUCTOR, TERMINATORS, AND ACCESSORIES

2.1.1 750 KCMIL

A. 750 kcmil Copper cable, 15 kV, XLPE-TR, 133% insulation, HDPE jacket
B. Termination kits, Cold Shrink, 3M Catalog No. 5637 for use outdoors and 3M Catalog No. 5625K for use indoors.
C. Accessories
   1. Lugs 750 kcmil cable, 3M 31000 Series
   2. Mounting Brackets for 750 kcmil cable, 3M Catalog No. MBS-6

2.1.2 500 KCMIL

A. 500 kcmil Copper cable, 15 kV, XLPE-TR, 133% insulation.
B. Termination kits, Cold Shrink, 3M Catalog No. 5602 for use outdoors and 3M Catalog No. 5624K for use indoors.
C. Accessories
   1. Lugs 500 kcmil cable, 3M 31000 Series
   2. Mounting Brackets for 500 kcmil cable, 3M Catalog No. MBS-5

END OF SECTION 16804

SECTION 16805

STAINLESS STEEL STATIC WIRE

1.0 GENERAL. The section covers furnishing of static wire. The Contractor shall include furnishing and installing all accessories.

2.1 PRODUCTS

3/8" Diameter Stainless Steel Static Wire

- Highly corrosion resistant AISI 316
- Breaking strength 18,000 lbs.

Provide extra high-strength and utilities grade stainless steel wire specifically intended for use as overhead ground wires or static wires for electric transmission lines. The strand shall have a left lay with a uniform pitch of not more than 16 times the nominal diameter of the strand.

Manufacturer:

Coastal Line Products Inc.
Techni-Cable

END OF SECTION 16805

SECTION 16998

INSTALLATION TESTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements

B. Testing references

C. Test report

D. Qualifications of testing agency

1.2 REQUIREMENTS

A. Perform installation tests by an independent testing agency hired by CONTRACTOR. Prepare and submit test plans, which shall formulate complete test procedures for all work provided under the Contract. Test procedures shall be complete to verify proper connection and operation of systems and equipment. Provide test sheets identifying each test step for all tests conducted, including columns indicating correct or incorrect operation, comments, and initials of personnel performing tests.

B. Furnish tools, instruments, material, test equipment, test connectors, and personnel for testing and adjusting of equipment.

C. Care and Precautions:

1. CONTRACTOR shall be responsible for personnel safety and all damage to equipment and power system due to improper application of test procedures or test apparatus handling. Replace or restore to original conditions the damaged equipment, material, or system.

2. Furnish and use safety devices such as rubber gloves and blankets, protective screens and barriers, and post danger signs to adequately protect and warn all personnel in the vicinity of the tests.

1.3 TESTING REFERENCES

A. Conduct testing in accordance with the following:

1. These specifications.
2. Manufacturer's recommendations.
3. Acceptance standards of the National Electrical Testing Association.
4. Testing standards of the Institute of Electrical and Electronics Engineers.
5. Testing standards of the American National Standards Institute.
6. Insulated Cable Engineers Association.
7. Instructions from Field Service Engineer and OWNER.
8. National Electrical Manufacturer's Association.
9. National Electrical Code.
10. American Society for Testing Materials.

1.4 TEST REPORT

A. Record test values and results of tests made on equipment and system. Submit certified copies to OWNER.

B. Include in the report the following:

1. Date issued.
2. Project title and location.
3. Names of tester.
4. Date and time of testing.
5. Identification of equipment or system tested.

6. Identification of specification section.

7. Types and procedures of tests performed in accordance with these specifications.

8. Include make, model, serial number, and test function of all instruments used in testing.

1.5 QUALIFICATIONS OF TESTING AGENCY

A. The testing firm shall be a member of National Electrical Testing Association and is exclusively engaged in independent testing of electrical installations.

B. Personnel performing the test shall be technically qualified to perform tests specified herein and shall have performed similar independent testing for at least 5 similar projects during the last 10 years and shall have NETA certifications.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 INSTALLATION TESTS AND CHECKS

A. Test and check all equipment installed under the Contract to demonstrate that it is ready for operation, including alignment, instrument calibration, and electrical tests.

B. Perform the following equipment tests:

1. Control and Relay Switchboard:

a. Verify that all relays are set in accordance with OWNER's instructions and make corrections as necessary.

b. Calibrate and check phasing of input connections to metering circuits.

c. Check external cable connections to ensure correct terminations to field circuits, circuit breakers, and other interfacing equipment.

d. Check for correct phasing and polarities of incoming VT and CT leads.

e. Perform functional tests, including close, trip, alarm, and reclose functions, and proper interface with HMI system, using simulated conditions.

2. Instrument Transformers:

a. Physically check and confirm polarity mark orientations for all current and voltage transformers.

b. Check current transformer polarity markings. The following is a suggested method:

1) Connect dc permanent magnet ammeter with a scale less than 5 amperes across the current transformer secondary terminals with the meter plus lead connected to the marked terminal of current transformer.

2) Attach the negative lead of a 6-volt dry or wet cell to the unmarked terminal of the current transformer primary.

3) Touch the plus lead of the dry cell to the marked current transformer primary terminal; if the polarity as marked is correct, the meter will kick up scale, and on breaking the connection, the meter will kick down scale.

c. Check voltage transformer polarity markings, as follows:

1) Connect a dc permanent magnet voltmeter with a scale appropriate to voltage transformer ratio (0-150 volts or higher) across the high voltage terminals of the voltage transformer with the meter plus lead connected to the marked terminal of the potential transformer.

2) Attach the negative lead of a 6-volt dry or wet cell to the unmarked terminal of the voltage transformer; if the polarity as marked is correct, the meter will kick up scale, and on breaking the connection, the meter will kick down scale.

d. Check current circuits as follows:

1) Disconnect secondary wires at each current transformer.

2) Inject approximately 2 amperes ac into the circuit.

3) Check to see that current is present in each relay, switch, or auxiliary - equipment that should be connected to the current transformer being tested.

4) Use clip-on ammeter or test plug and ammeter for checking currents.

5) Repeat test for every current transformer circuit.

e. Check voltage circuits as follows:

1) Disconnect secondary wires at each voltage transformer.

2) Apply 115 volt ac to the circuit.

3) Check to see that voltage is present at relays, test switches and auxiliary transformers that should be connected to the transformer being tested.

4) Use voltmeter for checking voltage.

5) Repeat test for every voltage transformer circuit.

3. Station Service Transformer

a. Check and measure equipment ground to assure continuity of connections; notify the OWNER if ground resistance is more than 1 ohm.

b. Check electrical neutral of the transformer; this connection shall be a copper wire connection to the station ground grid.

c. Megger between high voltage winding and low voltage winding, high voltage winding and ground, and low voltage winding and ground; if readings are below 50 megohms (at 77°F) notify OWNER before energizing transformer. Test results shall include the voltage and serial number of the megger and the duration of the test.

d. Ratio test the full winding and all taps; set transformer taps as directed by OWNER.

e. Check all wire and cable connections for tightness and clean out dust and debris from control cabinets.

C. Perform the following wiring tests:

1. Test wire, cable, and electrical equipment furnished, installed, or connected by CONTRACTOR to assure proper installation, setting, connecting, and functioning in accordance with manufacturer's instructions.

2. Correct errors in interconnecting wiring or internal equipment wiring to obtain correct operations of all equipment.

3. Power Cables

a. Perform the following tests on each cable circuit after installation of the entire length of cable run and completing all terminations.

b. Disconnect equipment normally connected to the power circuit from the cable to be tested.

1) Perform a continuity test to prove the continuity of the conductor. Tag both ends of the cable with the circuit number immediately after the test.

2) Perform a phasing test to establish the phase identification of the conductors of a cable. Perform tests at both ends of a length of installed cable.

c. Defective Cable: Replace, if found defective during the testing, with new cable at CONTRACTOR's expense. Correction of defects shall be done only with the specific approval of OWNER.

d. Defective Terminations: Replace with new terminations at CONTRACTOR's expense. Correction of defects shall be done only with the specific approval of OWNER.

4. Control Cables

a. Megger control cables with a 500-volt megger for 1 minute after installation, but with circuits disconnected from control panels and other equipment. Megger reading shall not be less than 600 kilo-ohms.

b. Check all control wiring for proper connection in accordance with the control wiring diagrams.

c. Check terminal contacts for tightness and continuity, especially of current t ransformer leads, through each run of control circuiting.

d. Thoroughly verify by means of battery powered bells or telephones all wiring.

e. Follow these procedures for each control circuit cable.

5. Automatic Transfer Switch

a. Test the switch by connecting normal and standby sources; de-energize normal source and observe that switch transfers to standby source and then returns to normal source when it is restored.

b. Adjust all contacts for proper alignment and minimum arcing.

c. Observe that all auxiliary contacts perform their intended functions.

6. Panelboards and Battery Charger

a. Check frame and neutral grounds for continuity.

b Megger each phase bus for freedom from grounds.

c. Test molded case breakers for proper operation.

d. Check operation of battery charger.

e. Check charger changeover from Normal to Standby operation.

7. Ground System

a. Tests shall include measurement of ground resistances at the following equipment and structures:

1) Current transformers and voltage transformers.

2) All control panels.

3) Other miscellaneous grounds selected at random in a manner to be representative of the entire installation.

4) Check that each CT circuit is grounded at one location only. The only ground shall be at the associated relay or switchboard panel.

b. Test shall be made using a commercial instrument such as the "Groundohmer" ground tester as manufactured by James G. Biddle Company of Philadelphia, Pennsylvania, or "Vibro-ground" tester as manufactured by Associated Research, Inc., of Chicago, Illinois, or equal.

c. All tests shall be made to the same reference point.

d. Record all values and submit to OWNER.

8. Control Wiring Testing:

a. Test electrical wiring by trial operation of control equipment to see that each interlock, control, and alarm function operates according to control diagrams and in accordance with manufacturer's schematics and instructions.

b. Furnish labor and supervision required to identify cause of malfunction and to correct miswiring or defective equipment, including deletions or additions, necessary to obtain intended operation.

c. Furnish incidental materials such as wire, connectors, markers, jumpers, and lugs required to repair, replace, or complete the wiring.

D. Protective Relays:

1. Prepare functional test sheets for protection, control, and alarm circuits and submit to OWNER for approval.

2. Perform functional tests of protective and control devices to ensure that devices and circuits perform as required under normal and fault conditions.

3. Measure currents in protective relays as part of the primary injection tests specified herein.

4. Check operations of protective relays:

a. Check multi-function relays under simulated fault conditions and in accordance with manufacturer’s instructions.

b. Check bus differential relays under simulated fault conditions and in accordance with the manufacturer's instructions.

E. Communications Relays:

1. Prepare functional test sheets and submit for OWNER’s approval.

2. Verify data display and data gathering functions with data being available for output to external devices.

3. Verify data and program downloading to and uploading from personal computer.

F. Other Equipments: Perform equipment test on other equipments not listed above but essential to the completion of the project in accordance with NETA and testing standards as listed on this Section.

3.2 EQUIPMENT PROTECTION

After equipment has been tested, protect equipment to ensure that subsequent operation or testing of other equipment or systems does not disturb, damage or otherwise interfere with the functional capability of tested equipment.

3.3 DRYING OUT

If tests indicate the necessity for drying out equipment because of moisture absorbed during storage due to CONTRACTOR's failure to properly protect the equipment, the costs of required corrective action shall be at CONTRACTOR's expense.

END OF SECTION 16998

SECTION 16999

ENERGIZATION AND STARTUP

PART 1 GENERAL

1.1 SECTION INCLUDES

Energization and startup.

1.2 REFERENCES

A. Perform all checks and tests in accordance with the following:

1. These specifications.
2. Manufacturer's recommendations.
3. Testing standards of IEEE.
4. Testing standards of ANSI.
5. ICEA.
6. NEC.
7. Testing standards of ASTM.
8. NEMA.
9. Testing standards of the AEIC.
10. Acceptance standards of the National Electrical Testing Association (NETA).

1.3 ENERGIZATION PLAN

A. Prepare plans for energization and cutover for approval.

1. Formulate complete energization procedures for all equipment furnished or modified by CONTRACTOR. Procedures shall be complete and specifically prepared for the project. Generic procedures are not acceptable.

    a. To maintain continuity of system protection during cutover, parts of the existing control and protective relaying circuits need to be in service. Detailed procedures shall be submitted to specify how this will be achieved.

    b. Do not cutover more than one bus at a time. Follow GPA's operating procedures.

B. OWNER reserves the right to make necessary changes to submitted procedures. CONTRACTOR shall conduct all activities in accordance with approved procedures.

1.4 PROTECTION AND SAFETY

A. Assume total responsibility for damages to equipment, material, or power system in general, due to improper test procedures or test apparatus handling. Replace or restore to original conditions all damaged equipment, material, or system.

B. Assume total responsibility for safety of all personnel involved in the test.

C. Properly protect equipment tested and checked for operation to ensure that subsequent testing of other equipment or systems does not disturb, damage, or otherwise interfere with functional capability of such equipment.

1.5 NOTICE

Provide a 30 day written notice of tests to OWNER.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 GENERAL

A. Conduct functional tests to ensure proper operation of equipment and proper calibration and coordination of protective devices. Furnish and prepare all special equipment required for these tests, if any.

B. Furnish labor, material, drawings, documentation, test procedures, test instruments, and services necessary to perform required testing of equipment.

C. Successfully complete all tests to show that equipment meets specification requirements and that equipment and devices operate as intended.

D. Evaluate test results and advise OWNER immediately of any discrepancy between test results and expected results. Include acceptable tolerances for all measurements.

E. Record test measurement, including evaluation of testing results, on forms approved by OWNER.

F. Provide safety devices including, but not limited to, rubber gloves and blankets, barriers, danger signs, and padlocks, to protect and warn all personnel during the tests.

G. Provide a certified calibration sticker showing last date of calibration and expiration date on each test instrument used.

3.2 FUNCTIONAL TESTS

A. Alternating Current and Voltage Circuits:

1. General:

a. Apply 3 to 5 amperes, 60 Hz at CT secondary circuit for current tests. Ensure that short-time rated devices are not damaged by overheating.

b. Apply 90V to 120V, 60 Hz at VT secondary circuit for voltage tests. Prevent back energizing any primary circuits.

c. Perform tests that correctly simulate actual operating conditions in phase and magnitude for devices operating on both current and potential and for devices operating on three-phase quantities.

d. Select current and voltage test connection points such that all secondary wiring and terminal blocks associated with a given CT or VT has been tested by primary or secondary test injection.

2. Alternating Current and Voltage Tests:

a. Inject current into CT secondary circuits at CT locations with three-phase test source. Verify that proper connections have been made by checking current magnitude and phase angle at each device.

b. Apply voltage to VT secondary circuits at VT locations with three-phase test set. Verify that proper connections have been made by checking voltage magnitude and phase angle at each device.

c. Test transducers and calibrate by injecting currents and voltages, as required. Test all HMI interface circuits, including control, status, and analog values.

B. Direct Current Control Circuits:

1. Make functional test of dc control circuits with all equipment in operating position.

2. Test each contact for proper function. Demonstrate that circuits do not function if incorrect operating sequence is applied.

3. Where possible, verify all relay operation by visible target or message display.

C. HMI Interface:

1. Verify wiring between connectors and terminal blocks and HMI.

2. Verify correct information or data is passed between the relays and HMI.

D. Auxiliary Circuits:

1. Energize auxiliary circuits from appropriate locations.

2. Check correct operations of all auxiliary equipment such as heaters, thermostats, air conditioners, lights, batteries, battery charger, receptacles, and panelboards.

3.3 PREPARATION FOR ENERGIZATION AND CUTOVER

A. General

1. All equipment shall have been properly installed, adjusted, tested, thoroughly cleaned, and painted by CONTRACTOR before equipment will be accepted by OWNER for energization.

    a. All circuits shall have been meggered, checked for continuity and grounds, properly and accurately connected, and checked for tightness.

    b. All equipment shall have been thoroughly cleaned inside and outside of all dirt, grease, grit, conductor strippings, metal fillings, and any other foreign matter, and all items shall have been properly cleaned and touch-up painted, as directed by OWNER.

    c. All protective relay cases and associated auxiliaries shall have been thoroughly blown out with dry nitrogen gas and checked for the proper operation of all jack contacts and shorting bars and/or built-in test switches and shorting bars.

    d. All identification markers and nameplates shall have been properly and accurately installed.

    e. All high-voltage connections shall have been accurately torqued.

    f. The alignment of all working parts shall have been checked, all adjustable devices calibrated and set at their proper operating values, any and all preliminary functional and/or operational tests required for satisfactory operation thoroughly complete.

2. Prior to energizing any substation bus, visually check for grounds and conduct an insulation resistance test with a 2,500V megger. Hold each measurement until reading reaches a constant value.

B. Placing into Service

1. Do not energize equipment unless OWNER has approved CONTRACTOR's energization procedure. All energization and switching into service shall be performed under direct supervision and ONLY as directed by OWNER.

2. Perform complete phasing checks on primary side of equipment prior to closing any switches or circuit breakers.

3. After verification of phasing of energized primary facilities, make a complete phasing check of VT circuits to ensure proper operation.

3.4 CALIBRATION AND ADJUSTMENT

A. Perform final calibration of instrumentation and control systems; demonstrate that controls will permit fully automatic operation.

B. Perform all routine maintenance required until systems are accepted for operation by OWNER.

3.5 SAFETY

CONTRACTOR shall be responsible for personnel safety and any damage to equipment during startup.

END OF SECTION 16999

SECTION 16051

OWNER-FURNISHED EQUIPMENT AND MATERIALS

3A.1 GENERAL. The electrical equipment and materials described in this section will be furnished by the Owner under separate specifications for installation by the Contractor.

Except as indicated otherwise herein, all work, materials, and additional equipment required for complete erection of the equipment, including receiving from carriers, unloading, and storage prior to erection, shall be provided by the Contractor.

Information describing equipment included in this section will give only an approximate scope of the erection work and is not intended to be a detailed itemization of all work to be done as a part of these specifications. Equipment purchase specifications for Owner-furnished equipment may be examined at the offices of the Owner. If necessary, supplemental information may be obtained from the manufacturer concerning the extent of field erection work. The weights and dimensions given are approximate.

Two copies of all manufacturer's shop drawings will be furnished to the successful bidder.

All spare parts and maintenance tools provided with equipment shall be delivered to the Owner as directed.

3A.2 DESCRIPTION. The following equipment and materials will be furnished for the substation as indicated in this Section.

3A.3 DELIVERY. The owner-furnished equipment and materials are scheduled to be shipped Delivered Duty Paid (DDP) site. The Contractor shall be responsible to transport owner-furnished equipment and materials from the Owner’s designated storage site to the job site.

3A.4 INSTALLATION. The Contractor shall install the equipment and materials complete as indicated on the drawings as specified and in accordance with the manufacturer’s drawings and recommendations. The Contractor shall be responsible for testing and energizing the owner-furnished equipment and materials.

END OF SECTION 16051

SECTION 16355

POWER TRANSFORMER 34.5/13.8 KV 30 MVA

1.0 GENERAL. The section covers furnishing of the 34.5/13.8 kV power transformer complete with surge arresters, insulating oil, and accessories as indicated in GPA Specification No. E-034. Equipment furnished shall be complete with all accessories ready for mounting, assembly, connection, and immediate service. The Contractor shall furnished ASTM A-307 anchor bolts with heads embedded 12 inches in concrete with an ultimate compressive strength of 3000 pounds per square inch.

END OF SECTION 16355

SECTION 16374

CONCRETE POLE

1.0 GENERAL. The section covers furnishing of concrete pole as indicated in GPA Specification No. E-009. The Contractor shall include furnishing and installing all accessories.

2.1 PRODUCTS

CONCRETE POLE (HEIGHT AS INDICATED)

Provide precast concrete poles or precast prestressed poles for use in overhead steam distribution systems. Precast prestressed concrete poles or precast concrete poles shall be the product of a manufacturer specializing in the production of precast concrete members. Prestressed concrete poles shall be designed in accordance with PCI MNL-120 or precast concrete poles shall be designed as indicated. Produce poles in one piece, and in accordance with PCI MNL-116.

END OF SECTION 16374

GEO-ENGINEERING & TESTING, INC.
Geotechnical and Material Testing Engineers
P.O Box 8170, Tamuning, Guam 96931
Telephone: 671-646-7710
Facsimile: 671-646-6600

02 November 2012
343.22

EMCE Consulting Engineers
Suite 201, 133 Antonia Court
Tamuning, Guam 96931

Attention: Mr. Alex Andres

Gentlemen:

Report
Subsurface Soil Investigation
Dededo Indoor Substation
Dededo, Guam

Introduction

This report presents the result of the subsurface soil investigation we performed at the Dededo Indoor Substation in Dededo, Guam. The proposed building is planned for construction at the east end of the existing Dededo Substation.

We understand that the project will consist of a single story reinforced concrete switchgear building that will be approximately 46 feet by 81 feet in plan dimensions, and with concrete on-grade floor slabs. The project also includes two transformer enclosures on the north and south side of the planned building, and a mobile substation at the south end of the existing substation. Two percolation basins are also planned for construction along the south end of the existing substation. A concrete retaining wall is also planned along the west side of the planned building. We should be informed of any changes of locations for all the proposed structures so we can modify our recommendations.

The purpose of our investigation was to explore the subsurface conditions at the building site and, to provide discussion and recommendations concerning the earthwork and foundations, generally as follows:

1. General subsurface conditions at the building site (based on interpretation of the test boring information obtained).

2. Excavations and backfills for the underground utilities, soil material criteria, placement and compaction requirements.

3. Foundation support and design subgrade soil parameters for the new building.

4. Subgrade preparation for concrete on-grade slabs.

5. Lateral earth pressure for retaining structure design.

6. Percolation rates for storm-water runoff disposal design.

7. Resistivity tests for corrosion characteristics of the underlying soil.

Subsurface Exploration

We explored the subsurface conditions at the project site by drilling two test borings utilizing an 8-inch diameter truck mounted hollow stem auger drilling rig. The depth of the test borings was 32 feet below the existing surface. We also conducted 2 resistivity tests to determine the corrosion characteristics of the underlying soil. The approximate locations of the test borings are shown on the attached Plate 1.

During the subsurface exploration at the project site, we logged the subsurface materials that were encountered in the test borings and obtained subsurface soil and rock samples for visual examination, field classification, and limited laboratory testing. The log of the test borings are shown on Plates 2 and 3. We have described the soils in accordance with the Unified Soil Classification System presented on Plate 4.

Percolation Tests

We also conducted two percolation tests at the approximate location shown on Plate 1 as PT-1 and PT-2. The percolation tests were excavated down to approximately 2.75 and 2.5 feet in PT-1 and PT-2 below the existing ground surface, respectively. Percolation test 1 exposed soft, reddish brown gravelly silt overlying moderately hard, light brown-white coralline limestone throughout the depth of the test hole. Percolation test 2 exposed stiff, dark reddish brown clayey silt, followed by dense, light brown-white silty sandy limestone gravel, overlying moderately hard, light brown-white coralline limestone throughout the depth of the test hole.

We first saturated the percolation test holes before beginning the percolation tests. The following results were obtained:

Percolation test	Overall rate, inches/minute	Last rate, inches/minute	Recommended rate, inches/minute
1	0.270	0.117	0.135
2	0.146	0.060	0.060

Laboratory Testing

In our laboratory, we tested selected soil and rock samples obtained from the project site to determine their in-situ moisture content, dry density, and particle size distribution (sieve analysis). The results of the tests are presented on the test boring logs in the manner described by the Key to Test Data shown on Plate 4, and on Plate 5.

Subsurface Conditions

Test Borings 1 and 2 exposed similar soil condition consisting of 0.25 feet thick of medium stiff, reddish brown sandy silt, and 1.5 feet thick of medium dense, silty sandy limestone gravel soil fill. These are immediately underlain by generally hard, with a thin layer of weak and moderately hard, light brown-white native coralline limestone to the 32-foot depth of the borings.

The elevation of the general area of the project site is high and permanent groundwater at the site should lie significantly below the ground surface. Therefore, any groundwater effects should have no significance to the project.

Discussion and Recommendations

The underlying, shallow native coralline limestone formation will provide good subgrade support for the new building. Therefore, the new building can be supported on conventional, shallow spread footings and/or conventional wall footings resting on the natural coralline limestone or on densely compacted, limestone sand and gravel soil.

Details of our recommendations are presented in the remainder of this report.

Clearing and Stripping – Initially, the area to be graded should be cleared of vegetation, trees to be removed, trash and debris. Topsoil containing roots should be stripped and removed away, or can be stockpiled at the site for later reuse for landscaping, if it is desired.

Additional Excavation - After clearing and stripping are made, within the planned building and their exterior concrete on-grade slabs or side walks, including at least 3 more feet horizontally beyond, any exposed reddish brown silty soil within the top 1.5 feet of the final subgrade elevation should be entirely excavated for replacement with compacted, non-expansive limestone sand/gravel soil fill.

Fill Soils and Placement - All fill and backfill soils should be free of organic matter, debris, and rock fragments or lumps larger than 4 inches or one-half of the compacted layer thickness, whichever is less, in greatest dimension. In addition, the fill and backfill soils within the building concrete floor slabs and sidewalks, driveways and parking, including at least 3 more feet wider all around their edges, should be non-expansive with plasticity index 12 maximum, liquid limit no more than 35 and contain no more than 30 percent finer than no. 200 mesh sieve (silt and clay sizes), but should have adequate sand for dense compaction.

Approved fill soils should be placed in 10-inch maximum loose layers, moisture conditioned as necessary and compacted to at least 95 percent of its maximum dry density (MDD).

The on-site excavated, limestone silty sandy gravel soil meeting the above criteria are suitable for use as fill and backfill soil.

Cut and Fill Slopes – should not be steeper than 2:1 horizontal to vertical ratio. The final slope surfaces should be covered with rapid grass or vegetation growth to minimize surface erosion. Cut slopes in massive and moderately hard to hard limestone can be steeper to 1:1 slope ratio but may not be able to plant surface grass or vegetative growth to minimize surface erosion.

Foundation Support

The planned building may be supported on conventional, shallow spread footings and/or continuous wall footings resting either directly on the natural coralline limestone formation or on densely compacted, approved limestone sand/gravel soil fill having at least 95 percent of its MDD. The footings can be designed with

the following criteria:

1. Allowable subgrade bearing pressures

Dead plus live loads (psf = pounds per square foot)	4000 psf
Total design loads, including wind or seismic forces	6000 psf

2. Resistance to lateral loads.

Friction across footing bottoms, (percent of total dead loads at the footing bottoms)	30
Passive soil resistance (triangular distribution for backfill with at least 95 percent MDD, on one footing face. Ignore top one foot if it is not directly covered with concrete slab or asphalt pavement. Pcf = psf per foot of depth, or pounds per cubic foot.)	600 pcf

3. Minimum footing bottom depth — 2 feet

4. Minimum footing width — 2 feet

During construction, where footing excavation exposes silty soil, including fine-grained silty fine sand, it should be entirely excavated and replaced with limestone sand/gravel soil fill compacted to at least 95 percent of its MDD in 6-inch compacted layers. The excavation and replacement should extend at least one foot horizontally around the affected footings.

The footings strictly constructed as recommended herein should be designed to tolerate ½-inch total and differential settlement across the width of the building.

Resistivity

Two soil resistivity tests were performed, one resistivity test along the east end one resistivity test along the south end of the property, utilizing a Nilsson Model

400 4-Pin Resistance Meter. The test results are tabulated below:

Test No.	Electrode Spacing (feet)	Resistivity Ohm-cm
R-1	5	32,555
	10	15,320
	15	15,320
	20	95,750
	25	47,875
R-2	5	9,575
	10	16,278
	15	124,475
	20	76,600
	25	4,788

The following table illustrates generally adopted corrosion severity ratings:

Soil Resistivity (ohm-cm)	Corrosivity Rating
> 20,000	Essentially non-corrosive
10,000 to 20,000	Mildly corrosive
5,000 to 10,000	Moderately corrosive
3,000 to 5,000	Corrosive
1,000 to 3,000	Highly Corrosive
< 1,000	Extremely corrosive

Subgrade Preparation for Concrete On-grade Slabs

The finished subgrade for the building on-grade concrete floor slab should have been compacted to a uniform, dense and non-yielding surface with at least 95 percent of its MDD, as recommended above. The concrete slabs should be directly underlain with at least 4 inches thick of crushed aggregate base course meeting standard road paving base course requirements, and compacted to dense and non-yielding with at least 95 percent of its MDD.

Where penetration of moisture vapor through the concrete on-grade slabs is objectionable, an impervious membrane should be placed between the compacted aggregate and the concrete slabs.

Retaining Walls

The planned retaining wall can be supported on conventional, continuous wall footing resting directly on natural coralline limestone, or on a layer of densely compacted, limestone sand/gravel fill as recommended above for building foundation support. The wall footings can be designed with the same designed values recommended for the building foundation support, except that the footings should be at least 3 feet below lowest adjacent finished grade, or 2 feet for walls less than 6 feet in height.

The retaining walls should be designed to resist active lateral earth pressure of 45 psf per foot of depth (or pcf = pounds per cubic foot) equivalent fluid pressure. However, with seismic consideration, the walls should be designed for 60 pcf, although there is no assurance of how the retaining walls will behave under severe earthquake shaking.

Wall backfill should have at least 2 feet wide of non-expansive, natural coralline limestone or limestone sand/gravel soil compacted to at least 95 percent of its maximum dry density immediately behind the walls, without over-stressing or damage the walls. However, the top one-foot thick of backfill should be densely compacted limestone sand/gravel fill. The limestone sand/gravel fill should be placed in 8-inch loose layers with the surface lightly compacted to dense and non-yielding without over-stressing the walls. The top 12 inches thick of wall backfill should consist of impervious silty soil or limestone fines compacted in two equal layers to at least 90 percent of its maximum dry density.

The contractor should not damage the wall during wall backfilling and compaction. Weep holes should be provided at the lower portion (but at least one foot above the final ground surface) of the walls.

The wall footings strictly constructed as recommended above should be designed to tolerate 1/2-inch total and differential settlement measured every 40-foot length of the retaining wall.

Construction Inspection and Testing

During construction, the site grading earthwork, foundation subgrade preparation and installation, should be performed under qualified engineering inspection and testing to ascertain that the works are performed in accordance with the project plans and specifications and our recommendations herein, and to modify our recommendations if unanticipated subsurface conditions are encountered. Inspection and testing will also provide quality control of the construction.

Investigation Limitations

The findings, opinions and recommendations submitted herein are based on the limited information obtained from the project site. Unanticipated subsurface conditions may be encountered during construction and cannot be fully determined by test borings.

This report has been prepared for the exclusive use of the project owner and his design team. It is not to be used for any other project or by others without the thorough review and specific written consent of this facility.

The following plates complete the subsurface soil investigation report we prepared for the Dededo Indoor Substation project located in Dededo, Guam.

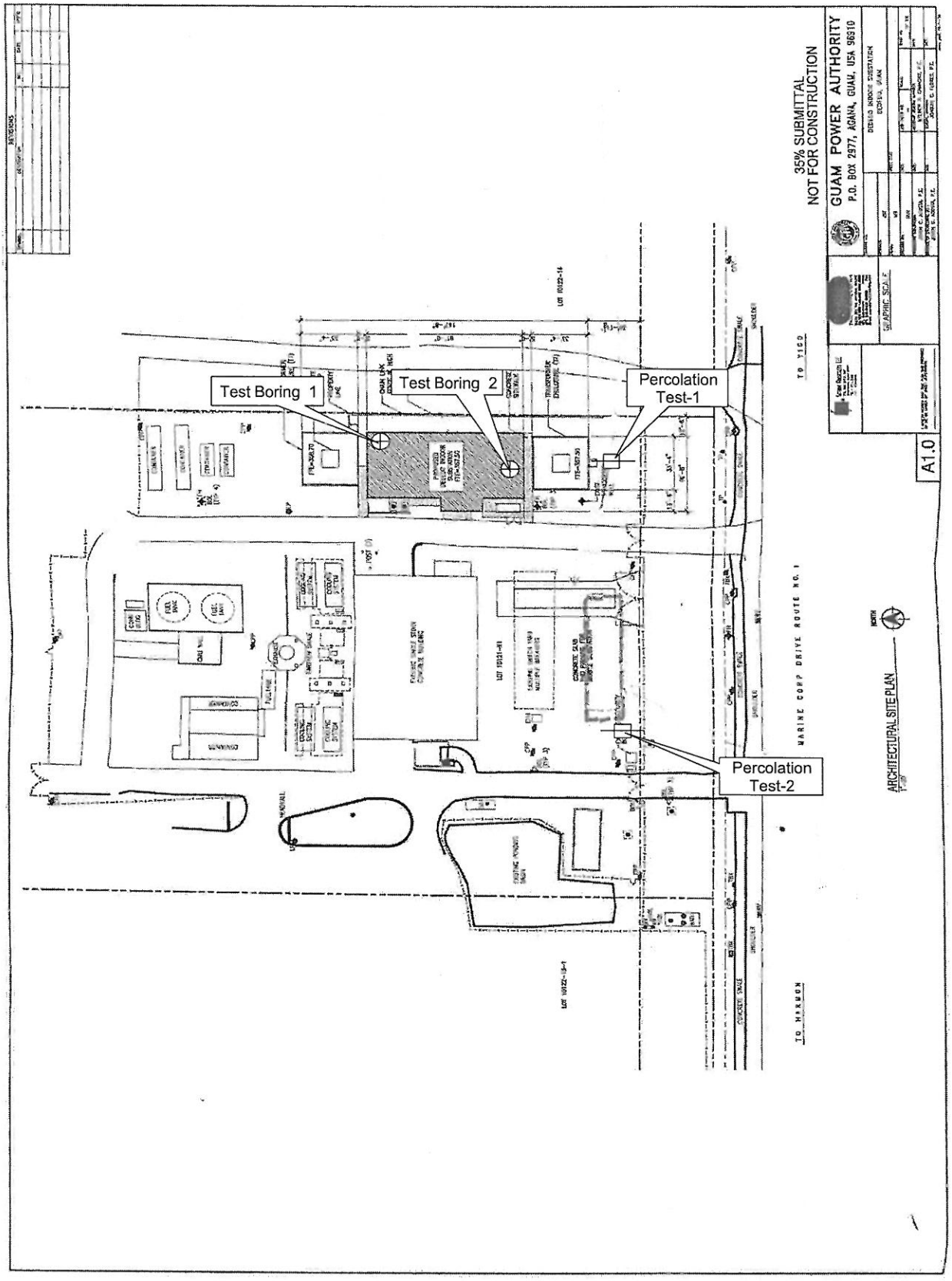
Plate 1	-	Test Borings and Percolation Test Location
Plates 2 and 3	-	Log of Test Borings 1 and 2
Plate 4	-	Soil Classification Chart and Key to Test Data
Plate 5	-	Particle Size Distribution Report

Respectfully submitted,

GEO-ENGINEERING & TESTING, INC.

Ukrit Siriprusanan

Ukrit Siriprusanan by
Civil Engineer – 360



GEO-ENGINEERING & TESTING, INC. Geotechnical & Material Testing Engineers	**TEST BORING & PERCOLATION TEST LOCATION** DEDEDO INDOOR SUBSTATION	**PLATE** **1**
Job No. 343,22 **Appr.** US/___ **Date** 08/16/2012	DEDEDO GUAM	

LOG OF TEST BORING 1

Notes:

Relatively Undisturbed Sample

Disturbed/Bulk Sample

SPT = Standard Penetration Test based on 140 lb (63.5 kg) hammer free falling 30 in (76 cm.)/blow

DATE August 06, 2012

EQUIPMENT 8" Dia. Hollow Stem Auger

ELEVATION --

DEPTH (FT.)	DEPTH (M.)	DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE	DRILL RATE (time/ft)	SPT (Blows/ft.)*	MOISTURE CONTENT, %	DRY DENSITY, pcf	LABORATORY TESTS
0	0	REDDISH BROWN SANDY SILT (MH) - medium stiff, moist, with short grass on surface							
		LIGHT BROWN-WHITE CORALLINE LIMESTONE - hard				53/7"	12.8	103	SA
	1								
5									
	2					41/2"			
10	3								
		moderately hard from 12' to 15'				35			
	4								
15		hard from 15'							
	5					60/5"			
20	6								
	7					10/0"			
25									
	8					44/1"			
30	9								
						25/1"			
		(no free water encountered)							

GEO-ENGINEERING & TESTING, INC.
Geotechnical & Material Testing Engineers

Job No. 343.22 Date 08/16/12

LOG OF TEST BORING 1

DEDEDO INDOOR SUBSTATION
DEDEDO, GUAM

PLATE 2

LOG OF TEST BORING 2

Notes:

Relatively Undisturbed Sample

Disturbed/Bulk Sample

SPT = Standard Penetration Test based on 140 lb (63.5 kg) hammer free falling 30 in (76 cm.)/blow

DATE October 16, 2012

EQUIPMENT 8" Dia. Hollow Stem Auger

ELEVATION --

DEPTH (FT.)	DEPTH (M.)	DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE	DRILL RATE (time/ft)	SPT (Blows/ft.)*	MOISTURE CONTENT, %	DRY DENSITY, pcf	LABORATORY TESTS
0	0	LIGHT REDDISH BROWN-WHITE SILTY SANDY LIMESTONE GRAVEL (GM) - medium dense, moist, with short grass on surface							
	1	LIGHT BROWN-WHITE CORALLINE LIMESTONE - moderately hard				33	14.6	93	SA
5									
	2	weak from 7'				25			
		hard from 9'							
10	3								
	4					44/7"			
15									
	5					24/1"			
20	6								
	7					10/0.5			
25									
	8					10/0"			
30	9								
		(no free water encountered)							

GEO-ENGINEERING & TESTING, INC.
Geotechnical & Material Testing Engineers

Job No. 343.22 Date 10/19/12

LOG OF TEST BORING 2
DEDEDO INDOOR SUBSTATION
DEDEDO, GUAM

PLATE 3

MAJOR DIVISIONS			SYMBOL		TYPICAL NAMES
COARSE GRAINED SOILS (MORE THAN HALF IS LARGER THAN # 200 SIEVE)	GRAVELS (MORE THAN HALF COARSE FRACTION IS LARGER THAN No. 4 SIEVE SIZE)	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW		WELL GRADED GRAVEL, WELL-GRADED GRAVEL WITH SAND
			GP		POORLY GRADED GRAVEL, POORLY GRADED GRAVEL WITH SAND
		GRAVELS WITH OVER 12 % FINES	GM		SILTY GRAVEL, SILTY GRAVEL WITH SAND
			GC		CLAYEY GRAVEL, CLAYEY GRAVEL WITH SAND
	SANDS (MORE THAN HALF COARSE FRACTION IS SMALLER THAN No. 4 SIEVE SIZE)	CLEAN SANDS WITH LITTLE OR NO FINES	SW		WELL-GRADED SAND, WELL-GRADED SAND WITH GRAVEL
			SP		POORLY GRADED SAND, POORLY GRADED SAND WITH GRAVEL
		SANDS WITH OVER 12 % FINES	SM		SILTY SAND, SILTY SAND WITH GRAVEL
			SC		CLAYEY SAND, CLAYEY SAND WITH GRAVEL
FINE GRAINED SOILS (MORE THAN HALF IS SMALLER THAN # 200 SIEVE)	SILTS AND CLAYS (LIQUID LIMIT LESS THAN 50)		ML		SILT, SILT WITH SAND OR GRAVEL, SANDY OR GRAVELLY SILT
			CL		LEAN CLAY, LEAN CLAY WITH SAND OR GRAVEL, SANDY OR GRAVELLY LEAN CLAY
			OL		ORGANIC SILT OR CLAY, ORGANIC SILT OR CLAY WITH SAND OR GRAVEL, SANDY OR GRAVELLY ORGANIC SILT OR CLAY
	SILTS AND CLAYS (LIQUID LIMIT GREATER THAN 50)		MH		ELASTIC SILT, ELASTIC SILT WITH SAND OR GRAVEL, SANDY OR GRAVELLY ELASTIC SILT
			CH		FAT CLAY, FAT CLAY WITH SAND OR GRAVEL, SANDY OR GRAVELLY FAT CLAY
			OH		ORGANIC SILT OR CLAY, ORGANIC SILT OR CLAY WITH SAND OR GRAVEL, SANDY OR GRAVELLY ORGANIC SILT OR CLAY
HIGHLY ORGANIC SOILS			Pt		PEAT AND OTHER HIGHLY ORGANIC SOILS

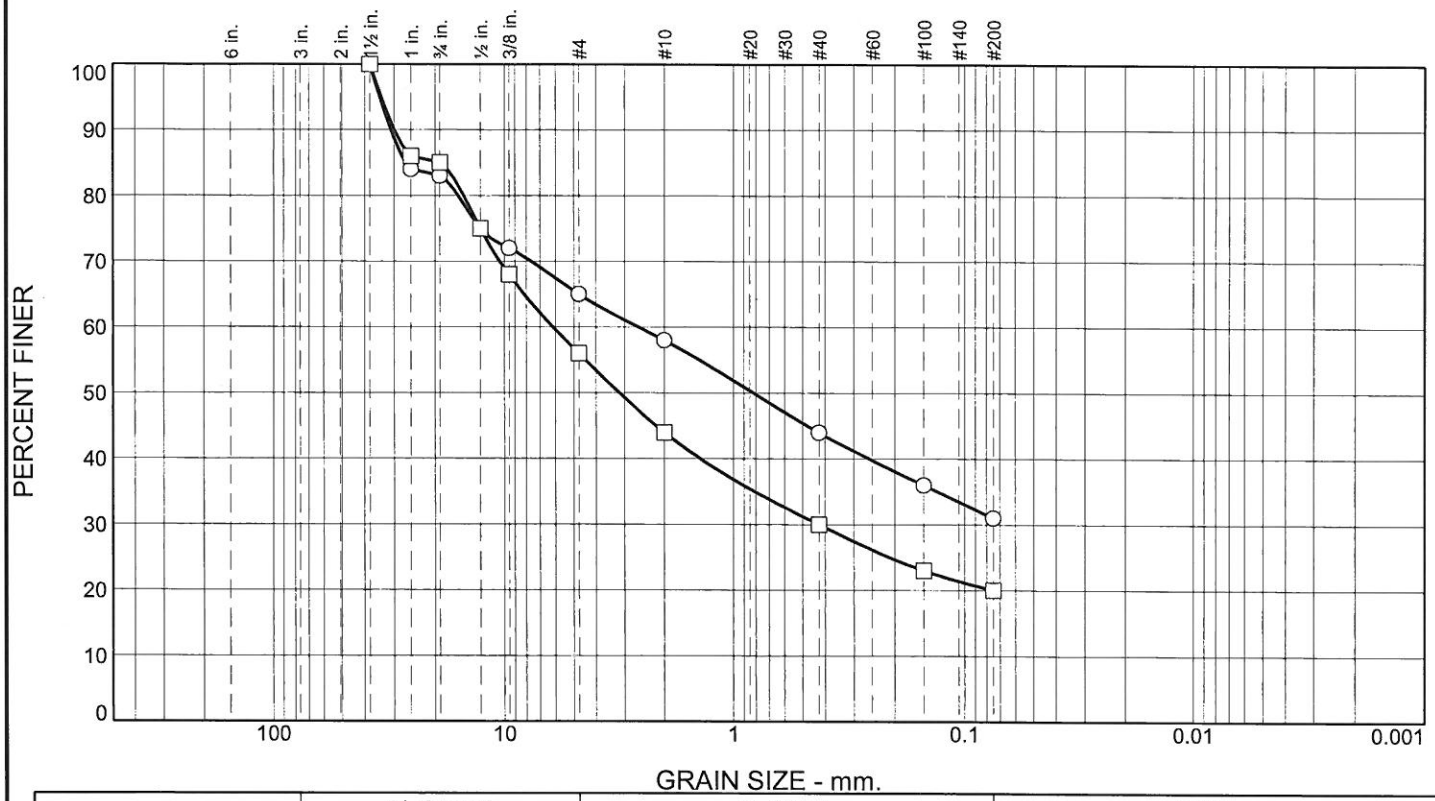
UNIFIED SOIL CLASSIFICATION SYSTEM

SA = Sieve Analysis (ASTM C117/C136)

☒ DISTURBED SAMPLE ■ RELATIVELY UNDISTURBED SAMPLE

GEO-ENGINEERING & TESTING, INC. **Geotechnical & Material Testing Engineers**	**SOIL CLASSIFICATION CHART AND KEY TO TEST DATA**	**PLATE**
Job No. 343.22 Appr. U.S. Date: 08/16/12	DEDEDO INDOOR SUBSTATION DEDEDO GUAM	**4**

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0	17	18	7	14	13	31	
□	0	15	29	12	14	10	20	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			26.7540	2.5970	0.8186					
□			19.0500	6.1463	3.1563	0.4250				

	Material Description	USCS	AASHTO
○	LIGHT BROWN-WHITE CORALLINE LIMESTONE	ROCK	
□	LIGHT BROWN-WHITE CORALLINE LIMESTONE	ROCK	

Project No. 343.22 **Client:** EMCE Consulting Engineers

Project: DEDEDO INDOOR SUBSTATION

○ **Source of Sample:** 1 **Depth:** 2

□ **Source of Sample:** 2 **Depth:** 3

Remarks:

GEO-ENGINEERING & TESTING, INC.

Geotechnical & Materials Testing Engineers

Plate 5

GUAM POWER AUTHORITY
P.O. Box 2977
Agana, Guam 96910

TRANSMISSION & DISTRIBUTION SPECIFICATION

Specification No. E-039
For

115 KV
AC POWER GAS CIRCUIT BREAKERS
OUTDOOR TYPE

115 KV AC POWER GAS CIRCUIT BREAKERS, OUTDOOR TYPE

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115 KV AC POWER GAS CIRCUIT BREAKERS, OUTDOOR TYPE

1.0 SCOPE

1.1 This specification covers GPA's requirements for 115 kV outdoor type power circuit breakers and accessory equipment, furnished complete in ratings herein specified, inclusive of all accessories ready for immediate service.

1.2 The breaker is intended for use in tropical weather conditions with corrosive, sea air atmosphere, wind strengths of 175 mph, and subject to moderate to severe earthquakes.

2.0 CONFORMANCE TO SPECIFICATION REQUIREMENTS:

Breakers shall meet the requirements of the following standards and specifications, including latest revisions with respect to material, design, and tests.

2.1 Applicable Standards

American National Standards Institute, Inc. (ANSI)

C37 Series	AC High Voltage Power Circuit Breakers
C57.13-1978	Requirements for Instrument Transformers
C76.1-1976 and C76.2-1977	Requirements for Outdoor Apparatus Bushings

National Electrical Manufacturers Association (NEMA)

CC1-1977	Electric Power Connectors for Substations
SG4-1975	High Voltage Power Circuit Breakers

American Society for Testing and Materials (ASTM)

A153-78	Zinc coating on hardware
B117	Salt Spray Testing

2.2 DEVIATIONS AND NON-CONFORMANCE REQUIREMENTS:

2.2.1 Deviations from this specification or changes in the material or design after the purchase order has been placed must be approved by the Guam Power Authority's Engineering Department and acknowledged by a Purchase Order Amendment.

2.2.2 Units received with deviations or non-conformance, which are not acknowledged as specified in sub-paragraph 2.2.1, are subject to rejection. The supplier of units rejected in this paragraph is responsible for any corrective action including but not limited to materials, labor, and transportation necessary to dispose of, or make the units conform to the specification.

2.2.3 Notification of defective units discovered before or after installation that are believed to be inherent to manufacturing problems or workmanship shall be forwarded to the supplier. The description of the item, documentation of the problem and the desired information, disposition and/or follow-up (as appropriate) that GPA expects from the supplier will be specified. The supplier's response shall be made within thirty (30) days unless otherwise noted or an extension is acknowledged and approved in writing by the Guam Power Authority's Engineering Department.

2.2.4 Breaker approval drawings which are outlined on Section 3.1 to 3.4 must be submitted to the Engineering Department for GPA's approval prior to delivery.

3.0 DATA TO BE FURNISHED

3.1. Outline drawings showing location and dimensions of frames and tanks, control cabinet, bushings, terminal connectors, operating mechanism, conduit and ground connections. This shall be submitted on a per circuit breaker basis.

3.2 Foundation diagram showing location of anchor bolts and information necessary for foundation design. This shall be submitted on a per circuit breaker basis.

3.3 Schematic and connection diagrams for supply and control circuits, showing the supply voltage and power required for operation. Wiring and schematic diagrams of control, current transformers, and heater circuits. This shall be submitted on a per circuit breaker basis.

3.4 Dimensional drawing of the bushing including complete dimensions of the bushing current transformers. This shall be submitted on a per circuit breaker basis.

3.5 Wiring and schematic diagrams shall be drawn in separate 11" x 17" paper with reproducible vellum. The right side of the paper at least ¼ of the total size shall be left blank for GPA's use. This shall be submitted on a per circuit breaker basis.

3.6 Six (6) complete sets of instruction books containing the following:

a. Instruction and data for ordering of all parts and accessories

b. Instructions covering installation, assembly, operation, maintenance, and adjustment of the operating mechanism and interrupting devices.

c. Copies of recommended spare parts lists.

d. Characteristic curves and data for bushing current transformers.

e. A list of maintenance tools being provided.

3.7 The breaker shall be provided with a permanent nameplate showing all of the information required including voltage, MVA, and current rating, BIL, weight, etc.

4.0 DESIGN AND CONSTRUCTION

4.1 Construction

4.1.1 Breakers shall be three-pole, frame or base mounted, and of oil-less type. For Gas Breakers, single pressure puffer type using SF6 gas as the insulation and arc quenching medium is required.

4.1.2 The circuit breaker design shall be dead-tank type with current transformers mounted on each side of the interrupters.

4.1.3 For SF6 breakers, the circuit breaker shall be capable of withstanding without damage or internal flashover 1.5 times nominal line-to-ground system voltage under one atmosphere of SF6 gas pressure. Under this condition, the circuit breaker is not required to open or close.

4.1.4 All steel frames shall be hot-dip galvanized, metalized, or painted with at least two coats of a zinc-rich primer.

4.1.5 The operating mechanism and necessary auxiliary and control devices shall be furnished in a stainless steel, weatherproof, dust resistant enclosure (control cabinet) mounted on the breaker frame. The breaker control cabinet shall provide the internal wiring for the breaker system and the interface between the Owner's control and power circuits to the breaker. The control cabinet shall allow sufficient space for termination of Owner-furnished control and power circuits.

Enclosure door handles shall include provisions for padlocking.

All control switches, push buttons, fuses, shorting type terminal blocks, and other devices requiring Owner interface shall be mounted at a height and location to be easily accessible. Such devices shall be located less than 5 feet but more than 2 feet above the top of foundation.

4.1.6 Each of the two grounding connections provided shall consist of a flat surface and bronze clamp-type connector attached with bronze bolts. The connectors shall be suitable for No. 4/O AWG stranded copper cable.

4.2 Operating Mechanism

4.2.1 The operating mechanism shall consist of either pneumatically-operated, hydraulically-operated, or a motor rewound spring-operated device.

4.2.2 The mechanism shall operate to open and close the three phases of the breaker simultaneously. The breaker shall be electrically trip-free and mechanically, pneumatically, or hydraulically trip-free if applicable and shall include anti-pump auxiliary relays and devices.

4.2.3 The operating mechanism shall include a mechanical position indicator. The indicator shall provide a positive indication of the breaker position by direct mechanical coupling to the operating rod. The indicator shall consist of a suitable sign utilizing green with the word "OPEN" when in the open position, and red with the word "CLOSED" when in the closed position.

4.2.4 The operating mechanism shall include dual, low energy type (below 10 amperes operating current) trip coils. The trip coils shall be electrically, mechanically, and magnetically independent. The trip coils shall be located such that heat or fire damage to one trip coil shall not preclude the proper operation of the other trip coil. The trip coils shall be suitable for parallel trip coil operation. Loss of dc voltage to one trip coil shall not impair the operation of the other trip coil or the breaker close mechanism. The trip coils shall be wired to individual terminals to allow independent activation and testing.

4.2.5 The pneumatic or hydraulic operating mechanism shall include a pressure gauge and pressure switch with two alarm contacts which close to alarm low air or oil/nitrogen gas pressure. A low-pressure cutout switch (with two alarm contacts) shall be provided to prevent initiating a close signal should the operating pressure be below the minimum required for a complete close-open operation. The low-pressure cutout device shall not prevent a complete close-open operation should pressure drop after the close-open operation is initiated.

4.2.6 The stored energy operating mechanism shall operate according to the duty cycle stated on the Specification and Data Sheets without auxiliary power available. Each operating mechanism shall store sufficient energy for

three close-open operations without the need for running pumps or compressors. If this requirement cannot be met, the breaker shall include an automatic throw over scheme to alternately supply the mechanism motor from the Owner's dc station service system should normal auxiliary power be lost. In such case, the requirement for emergency dc control power shall be clearly stated in the Proposal Data section as well as the duty cycle available without auxiliary power.

4.2.7 The stored energy mechanism recharging time to full operating pressure or condition from a completely discharged condition shall not exceed 1 hour.

4.2.8 The operating mechanism housing and any adjacent cabinet shall have blank removable floor plate for conduit connections to permit entrance of control circuits.

4.2.9 Provision shall be made for locking the mechanism housing doors with a padlock.

4.2.10 Push-button controls, or a control switch, mounted in the mechanism housing shall be furnished to permit electrical opening and closing of the breaker locally.

4.2.11 At least four spare terminals shall be provided. Terminal blocks for remote connections, except for current transformer leads, shall be provided with disconnecting links.

4.2.12 Extra auxiliary contacts (minimum of 3 each Normally Closed and Normally Open) shall be provided for Owner's use in addition to those normally required for breaker operation. Switch contacts shall have a voltage rating not less than 125 Vac and a continuous current rating not less than 15 amperes. The spare auxiliary switch contacts shall be mechanically linked to the mechanism operating rod and shall be field adjustable as either "a" or "b" contacts.

4.2.13 One permissive control switch (69 device) shall be furnished. It shall be a two-position, manually operated switch that in one position permits the closing of the circuit breaker and in the other position prevents the circuit breaker from being operated. It shall be mechanically interlocked with a manual trip lever that is accessible from outside the control cabinet so that, if the breaker is tripped by this lever, the 69 device must be manually reset

before the breaker can again be operated. The manual trip device shall electrically trip all three poles, with the 69 device being moved to the lockout position. The manual trip lever shall be painted red, shall have a guard to prevent accidental activation, and shall have a plastic engraved label worded "Emergency Trip."

4.2.14 Each breaker close control scheme shall include a field adjustable 0.1 to 1 second time delay pickup close relay, factory preset to provide a 20 cycle automatic recluse time (including breaker close time) after energization of the close circuit.

4.2.15 The compressor or pump motor for pneumatic or hydraulic mechanism furnished with the breaker shall be 230 volt or 115 volt single phase 60 Hz. See Specification Data Sheets for specific bid requirements.

4.3 Auxiliary Power Supply

The Owner will furnish one auxiliary power supply to each circuit breaker at the voltage specified on the Specification and Data Sheets. If the Supplier chooses to furnish motors or other auxiliary equipment designed to operate at a different voltage from the specified auxiliary power supply, he shall furnish all equipment required to transform the voltage of auxiliary power to the design voltage of the equipment furnished. The Supplier shall provide suitable branch circuit protection.

4.4 Auxiliary Power and Control Power Disconnects

Two power supply disconnects and four knife switches per breaker shall be provided. The close circuit and auxiliary power supply shall be fed from individual disconnects. One knife switch shall be wired in series with each of the disconnects feeding the auxiliary power supply and close coil. The type of disconnect device (molded case circuit breaker or fuse blocks) shall be as indicated on the Specification Data Sheets.

4.5 SF6 Gas System (As Applicable)

4.5.1 Temperature compensated pressure switches or gas density switches shall be provided to monitor the SF6 gas density.

4.5.2 A drop in SF6 gas density shall initiate a low SF6 gas density alarm. A further drop in density shall initiate a trip or block any further breaker operation as specified on the Specification and Data Sheets.

4.5.3 The breaker shall be furnished with sufficient SF6 gas to fill, test, and energize each breaker. The SF6 gas shall be free of moisture and impurities. SF6/nitrogen gas mixtures shall not be supplied.

4.5.4 The SF6 to air seals and gaskets shall prevent SF6 gas leakage in excess of 1 percent per year of gas weight, through the duration of the guarantee period. Corrosive arc products due to moisture infiltration shall be prevented to the maximum extent possible through the use of desiccant moisture absorbing chambers and an arc product filter.

4.6 Arc Containment Chamber

The arc containment chamber shall be designed to prevent mechanical failure and withstand pressure buildup if the breaker fails to interrupt full rated fault current. The use of a pressure relief device is acceptable and shall be so stated in the Proposal Data Section.

4.7 Dual Monitoring and Control System

The circuit breaker shall be furnished with dual alarm and control schemes which monitor the pneumatic or hydraulic operating system and the SF6 gas system (as applicable). The dual alarm and control schemes shall be mechanically and electrically independent with each alarm and control scheme wired into a separate trip coil circuit.

4.8 Space Heaters

4.8.1 Each enclosure furnished shall be provided with space heaters to prevent condensation of moisture within the enclosure. Space heater capacity shall be as required to maintain the enclosure internal temperature above the dew point. The heaters shall be spaced away and thermally insulated from any devices or painted surfaces.

4.8.2 Space heaters shall be sized to provide adequate heating when energized at the applied voltage indicated on the Specification Data Sheets. The

Supplier shall provide all space heater wiring integral to the breaker and suitable branch circuit protection.

4.8.3 Space heaters shall be controlled by an adjustable thermostat, factory set to close (ON) at 29° C (85° F) and open (OFF) at 35° C (95° F).

4.9 Current Transformers

4.9.1 Breaker shall be furnished with at least two multi-ratio relay-service CT's per phase as specified in the Specification Data Sheets. Current transformers shall be bushing type with fully distributed windings for relaying service. They shall be five lead multi-ratio type unless indicated otherwise on the Specification Data Sheets.

4.9.2 Each CT shall have a continuous current rating suitable for the breaker being furnished and shall be provided with polarity, secondary lead designations and diagrammatic nameplates.

4.9.3 Secondary and tap leads of each CT shall be brought out through conduits or ducts to suitable shorting type terminal blocks located in the circuit breaker control cabinet. Each set of secondary winding taps shall terminate on a 6-pole shorting block with the sixth pole permanently connected to the shorting bar and to ground.

4.10 Line Terminals

Breaker shall be provided with either pad or stud mount drilled in accordance with NEMA Standards. The terminal pad shall be of copper and shall be tinned for use with aluminum conductors.

4.11 Accessories

Breaker shall be equipped with the following accessories:

a. Any special tools required for installation or maintenance. This shall include a tank lifter.

b. An operation counter to record the number of breaker operations.

c. A selector-switch for "local" or "remote" operation.

4.12 Bushings

4.12.1 All bushings shall be rated in accordance with ANSI and NEMA standards and as specified on the Specification and Data Sheets. For SF6 gas breakers, all bushings shall be SF6 gas filled porcelain.

4.12.2 Any damage to porcelain, such as chips or cracks, shall result in the damaged item being replaced, not repaired.

4.13 Porcelain Color and Paint

4.13.1 All external porcelain shall be ANSI 255.1 No. 70 gray.

4.13.2 Except for electrical connection surfaces, all exterior circuit breaker metallic parts, including galvanized steel surfaces, support steel, raceway, etc., shall be painted. Breaker shall have finish paint color ANSI 45 or Bershire green.

4.14 Auxiliary Power and Control Circuits

Breaker auxiliary power, control and alarm circuits shall be provided with terminal blocks for connection to external circuits. The terminal blocks shall have circuit identification and shall be located in the control cabinet to provide external circuit connections from a common raceway entrance.

4.15 Assembly and Configuration

4.16.1 The circuit breakers shall be factory assembled into integral shipping sections as complete as possible to minimize assembly requirements at the site. A structural steel frame, common to all breaker components shall be furnished. The frame furnished shall maintain a 9'-0" minimum height from bottom of porcelain to top of foundation.

4.16.2 The assembly shall be complete including bushings, if shipping clearances will permit. Anchor bolts, nuts, and washers for the circuit breaker shall be provided and shall be ASTM A36/A36M threaded bars or ASTM A307 Grade B, heavy hexagon nuts conforming to ASTM A563 Grade A; flat or beveled washers.

4.17 Spare Parts

4.17.1 The Proposal shall include a list of spare parts included in the lump sum prices for each circuit breaker and an itemized list of spare parts that are recommended, but not included for each circuit breaker. The second list shall indicate the quantity recommended per circuit breaker, and the unit price each.

4.17.2 For SF6 gas breakers: one complete set of spare gaskets, O-rings, Dow Corning 111 (grease) and molecular sieve filters shall be furnished. The set shall contain all gaskets, O-rings, Dow Corning 111 and molecular sieve filters needed for one complete breaker including operating mechanism seals and SF6 gas-to-air seals.

4.17.3 For SF6 gas breakers: one gas tank full of SF6 gas, hoses, fittings and filter dryer shall also be furnished. Provide one Leak-Tec leak tester for every five breakers purchased.

5.0 TESTS

5.1 Certified test reports shall be conducted in accordance with ANSI C37.09.

5.2 The Supplier shall furnish two (2) certified copies of test reports of all the tests covered to the GPA Manager of Engineering within two weeks of breaker delivery.

5.3 Owner witness testing of breakers shall be required and included in the bid for order quantities of 4 or more power circuit breakers. Per diem rates will be provided by GPA at the time of the prebid.

5.4 Copies of the test reports shall be included in the instruction manuals for the breaker. Test reports for each circuit breaker shall be submitted and identified by serial number.

6.0 QUALITY CONTROL

The Supplier shall have a quality control program to assure compliance with the requirements of this specification. The program shall be documented and available for

GPA's review if requested. Documentation of the quality control program shall indicate where in the products and manufacturing process the quality checks are taken, describe the purpose of the checks and describe the nature of the check (e.g. if check is visual only or if electrical or mechanical testing is used).

7.0 PACKING AND SHIPPING

7.1 The breaker shall be placed and crated with suitable material to prevent damage and injury during shipment and handling operations. Breaker shall be securely blocked to prevent shifting during transit.

7.2 Circuit breaker components shall be clean, dry, and sealed when shipped from the factory. Each component not shipped with SF6 gas shall contain a packaged moisture absorbing chemical as required to keep it moisture free during shipment. Tanks, interrupters, support insulators, or other SF6 containers which are found to contain moisture when received at the jobsite shall be dried, and moisture damage shall be repaired at the Supplier's expense.

7.3 Complete instructions outlining the Supplier's recommended procedures for inspection upon receipt at the construction site, moisture free maintenance during storage, and preparation for SF6 filling shall accompany each breaker. These instructions shall be shipped inside the breaker control cabinet.

8.0 WARRANTY

The Supplier shall provide a warranty of at least one year for all parts and workmanship. The Supplier shall warrant that all equipment is free from defects.

9.0 SPECIFICATION DATA SHEETS

High voltage SF6 circuit breakers shall comply with the Technical Specifications and shall be furnished in accordance with the following requirements:

LOCATION AND QUANTITY

Each circuit breaker shall be designed and constructed for operation on a 3-phase, 60 hertz, solidly grounded system, at an ambient temperature range from +40° C to -30° C at an altitude below 3,300 feet.

Description and Use	Rated Continuous Current (Amps)	Quantity
115 kV Gas Circuit Breaker, (General)	1200	As required
115 kV Gas Circuit Breaker, Bus Tie	2000	As required

RATINGS

Description	Rating
Nominal Voltage	115 kV
Maximum Voltage	121 kV rms
Voltage Range Factor, K	1.0
Full Wave Impulse Withstand Voltage	550 kV peak
Continuous Current	As required from above:
Interrupting Current Rating (Symmetrical)	40 kA
Short-time Current Carrying Capability (3 seconds)	40 kA
Close and Latch Current Capability	64 kA
Interrupting Time	3 cycles
Rated Closing Time	0.1 seconds

Description	Rating/Scheme
Operator motor voltage	120 Vac
Control Voltage	125 Vdc
Breaker Closing	125 Vdc
Breaker Tripping	125 Vdc
Housing Heaters Voltage	120 Vac
Auxiliary Power	120/240 Vac, 60 hertz, 1-phase
Tripping Logic for low SF6 gas operating pressure	Block Trip and Close
Bushing BIL	500 kV
Bushing Ampere Capability	Match Line Breaker Rating
Bushing Creepage Distance	1 inch/kV
Control Power Disconnects	Fuse Blocks
Seismic Risk	Zone 4
Out-of-Phase Switching Capability	180°

Current Transformer Data

Type	Breaker Rating (A)	Ampere Ratio (A)	Quantity		Accuracy Relaying Class	Thermal Rating
			Per Bushing	Total		
Breaker (General)	1200	1200/5 MR	2	12	C800	1.5
Bus Tie (General) Or Line (Piti/Agana/Harmon/Tam)	2000	2000/5 MR	2	12	C800	1.5

ACCESSORIES

Standard accessories shall be provided with each breaker. Accessories shall include, but not necessarily limited to, the following as indicated.

Description
An auxiliary switch with 16 "a" and 16 "b" contacts in addition to those required for control of breaker mechanism. All contacts shall be wired to terminal blocks. Contact surfaces shall be silver-plated. Contacts shall be rated to break 6 amperes at 135 volts dc.
Four spare contacts from each Breaker 52X close relay, if relay is necessary for type of breaker supplied.
Cutoff and latch checking switches.
One local-remote control switch wired for local-remote operation and annunciation.
One trip-close push button station wired for local breaker test operation. One push button for each trip coil.
Pressure switch for annunciation of low operating pressure if pneumatically or hydraulically operated breaker is furnished.
One maintenance closing and opening device shall be furnished for use with all breakers at each substation site.
Position indicator visible from the outside of the control cabinet.
Loss of voltage alarm relay on each auxiliary power and control power feed to the breaker, one for the auxiliary power, one for close control power, and one for each of the trip coil circuits.
Operation counter to count trip operations.
One elapsed time meter for the stored energy mechanism motor.
120 volt ac lamp with door operated switch in the control cabinet.
Nameplates to identify switches, relays, and other auxiliary devices.
One 120 volt, single-phase receptacle, Hubbell Cat. No. 5251, and one 240 volt, 60 ampere, single-phase receptacle, NEMA Type 14-60R, shall be installed in each control and mechanism cabinet, and shall be accessible from outside the cabinet.

A suitable nameplate showing all ratios, accuracy classes, and thermal ratings of the current transformers shall be mounted inside the control cabinet.
One SF6 gas sampling valve for use in moisture testing.
SF6 gas system pressure gauge.
Density switch for annunciation of low SF6 gas density.
Density switch with 3 independent contacts for annunciation of low SF6 gas density cutoff.
Bushing terminals, NEMA 4 hole spade type, tinned bronze or silver plated aluminum, both sides of terminal suitable for electrical connections.
Two NEMA 2 hole grounding pads with tinned bronze, bolted type terminals for attachment to the Owner's 4/0 AWG stranded copper ground cables. The grounding pads shall be on diagonally opposite locations on the frame.
Interposing relays for remote trip and close of breaker if inrush current of trip and close coils is greater than 0.5 amps dc.

RECOMMENDED MANUFACTURERS

A. Siemens
B. Alstom
C. Areva/AEG

10.0 115 KV GAS CIRCUIT BREAKER BID TECHNICAL FORM

Description	Rating
Manufacturer	
Catalog No. and Type	
Nominal Voltage	
Maximum Voltage	
Voltage Range Factor, K	
Full Wave Impulse Withstand Voltage	
Continuous Current	
Interrupting Current Rating (Symmetrical)	
Short-time Current Carrying Capability (3 seconds)	
Close and Latch Current Capability	
Interrupting Time	
Description	
Rated Closing Time	
Operator motor voltage	
Control Voltage	
Breaker Closing	
Breaker Tripping	
Housing Heaters Voltage	
Auxiliary Power	
Tripping Logic for low SF6 gas operating pressure	
Bushing BIL	

Description	Rating
Bushing Ampere Capability	
Bushing Creepage Distance	
Control Power Disconnects	
Seismic Risk	
Out-of-Phase Switching Capability	

Current Transformer Data

Breaker Usage	Breaker Rating (A)	Ampere Ratio (A)	Quantity		Accuracy Relaying Class	Thermal Rating
			Per Bushing	Total		
Line Breaker (General)	1200	1200/5 MR				
Bus Tie (General)	2000	2000/5 MR				

SF6 Gas System

Description	Rating
Normal SF6 gas operating pressure, psig	
Minimum SF6 gas operating pressure for full interrupting capability, psig	
Minimum SF6 gas operating pressure for load current interrupting capability, psig	

Operating Mechanism

Description	Rating
Type	
Rated Duty Cycle	
Number of close-open operations that can be performed starting with a fully charged operating mechanism with no auxiliary electric power available	
If spring charged mechanisms are proposed, dc power requirement to recharge mechanism at dc voltage specified, amperes	
Time required to fully recharge operating mechanism to normal operating pressure or condition	
After one close-operation	
From zero operating pressure	
After one close-open operation and loss of auxiliary power (spring charged only)	
Maximum line to ground voltage breaker can withstand with one atmosphere SF6 gas pressure, kV	

Dimensions

Description	Response
Length	
Width	
Height	
Distance between lowest live part and top of foundation	
Total weight of circuit breaker with SF6 gas, lbs.	
Weight of largest piece for handling during erection, lbs.	

Description	Response
Maximum noise level during operation at 100 feet, dBA	
Will circuit breakers be fully assembled at factory for production tests?	
Will circuit breakers be shipped completely assembled except for filling with SF6 gas?	
If not shipped completely assembled, describe required field assembly.	
Method of shipment	
Maintenance interval (number of close-open operations) as defined by ANSI C37.06-1987 Table 8	

Spare Parts

List of spare parts and maintenance tools furnished with each circuit breaker, and included in the Proposal Price	

Accessories:

Description	Included
An auxiliary switch with 16 "a" and 16 "b" contacts in addition to those required for control of breaker mechanism. All contacts shall be wired to terminal blocks. Contact surfaces shall be silver-plated. Contacts shall be rated to break 6 amperes at 135 volts dc.	☐
Four spare contacts from each Breaker 52X close relay, if relay is necessary for type of breaker supplied.	☐
Cutoff and latch checking switches.	☐
One local-remote control switch wired for local-remote operation and annunciation.	☐
One trip-close push button station wired for local breaker test operation. One push button for each trip coil.	☐
Pressure switch for annunciation of low operating pressure if pneumatically or hydraulically operated breaker is furnished.	☐
One maintenance closing and opening device shall be furnished for use with all breakers at each substation site.	☐
Position indicator visible from the outside of the control cabinet.	☐
Loss of voltage alarm relay on each auxiliary power and control power feed to the breaker, one for the auxiliary power, one for close control power, and one for each of the trip coil circuits.	☐
Operation counter to count trip operations.	☐
One elapsed time meter for the stored energy mechanism motor.	☐
120 volt ac lamp with door operated switch in the control cabinet.	☐
Nameplates to identify switches, relays, and other auxiliary devices.	☐
One 120 volt, single-phase receptacle, Hubbell Cat. No. 5251, and one 240 volt, 60 ampere, single-phase receptacle, NEMA Type 14-60R, shall be installed in each control and mechanism cabinet, and shall be accessible from outside the cabinet.	☐
A suitable nameplate showing all ratios, accuracy classes, and thermal ratings of the current transformers shall be mounted inside the control cabinet.	☐

Description	Included
One SF6 gas sampling valve for use in moisture testing.	☐
SF6 gas system pressure gauge.	☐
Density switch for annunciation of low SF6 gas density.	☐
Density switch with 3 independent contacts for annunciation of low SF6 gas density cutoff.	☐
Bushing terminals, NEMA 4 hole spade type, tinned bronze or silver plated aluminum, both sides of terminal suitable for electrical connections.	☐
Two NEMA 2 hole grounding pads with tinned bronze, bolted type terminals for attachment to the Owner's 4/0 AWG stranded copper ground cables. The grounding pads shall be on diagonally opposite locations on the frame.	☐
Interposing relays for remote trip and close of breaker if inrush current of trip and close coils is greater than 0.5 amps dc.	☐

Miscellaneous

Description	Response
Allowable forces on bushing terminals, lbs:	
Horizontal (in-line)	
Horizontal (lateral)	
Vertical	
Foundation loading, lbs:	
Downward load (sum of breaker weight plus impact)	
Uplift load	
Is pressure relief device necessary? If yes, state the pressure at which the device will operate.	

Witness Testing for Order Quantities of 4 or More

Testing schedule, and included in the Proposal Price	

GUAM POWER AUTHORITY
P.O. Box 2977
Agana, Guam 96932

TRANSMISSION & DISTRIBUTION SPECIFICATION

Specification No. E-041

For

STATION BATTERY BANK

STATION BATTERY BANK

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STATION BATTERY BANK

1.0 SCOPE

This specification covers the requirements for furnishing, installing, checking, and testing of station battery bank and accessories.

2.0 CONFORMANCE TO SPECIFICATION REQUIREMENTS

2.1 Applicable Standards

The station battery bank shall meet the requirements of the IEEE, NEC, ANSI, and the Federal "Occupational Safety and Health Standards" specifications and guidelines including latest revisions with respect to material, design, and tests.

2.2 Deviations and Non-Conformance Requirements

2.2.1 Deviations from this specification or changes in the material or design after the purchase order has been placed must be approved by the Guam Power Authority's Engineering Department and acknowledged by a Purchase Order Amendment.

2.2.2 Units received with deviations or non-conformance, which are not acknowledged as specified in sub-paragraph 2.2.1, are subject to rejection. The supplier of units rejected in this paragraph is responsible for any corrective action including but not limited to materials, labor, and transportation necessary to dispose of, or make the units conform to the specification.

2.2.3 Notification of defective units discovered before or after installation that are believed to be inherent to manufacturing problems or workmanship shall be forwarded to the supplier. The description of the item, documentation of the problem and the desired information, disposition and/or follow-up (as appropriate) that GPA expects from the supplier will be specified. The supplier's response shall be made within thirty (30) days unless otherwise noted or an extension is acknowledged and approved in writing by the Guam Power Authority's Engineering Department.

3.0 DATA TO BE FURNISHED

The following data shall be provided:

3.1. Manufacturer's catalog data with size and type.

3.2. Physical arrangement drawings with elevation, plan view, and mounting details.

3.3. Wiring schematics and diagrams complete with interconnection requirements and capabilities.

3.4. Outline drawings with dimensions and other physical properties such as weight(s).

3.2 Six (6) complete sets of instruction books containing the following:

a. Instruction and data for ordering of all parts and accessories

b. Instructions covering installation, assembly, operation, and maintenance.

c. Copies of recommended spare parts lists.

4.0 DESIGN AND CONSTRUCTION

4.1 Construction

4.1.1 Each battery cell shall be lead-calcium alloy grid with micro-porous plastic separator construction, and use gelled electrolyte-dryout resistant technology. Battery System shall be EnerSys PowerSafe DDm50-17 or approved equal.

4.1.2 Cell containers shall be sealed, clear, shock absorbing, heat resistant plastic, explosion proof with pressure relief valves and post seals to eliminate leaking, and certified to UBC Zone 4 requirements.

4.2 Rating

The battery shall be rated in accordance with the following:

Nominal System Voltage	125 Vdc
System Description	2-wire, ungrounded
Minimum Ambient Temperature	40 degrees F
Quantity of Cells	60
Specific Gravity of Electrolyte, Fully Charged, Corrected to 77 degrees F	1.220
Voltage, volts per cell	
Floating	2.20
Final	1.75
Maximum during equalizing or recharging following during discharge	2.33
Ampere Hour Rating	400 (Minimum)

4.3 Rack

4.3.1 Each battery shall be furnished with one two-tier structural steel battery rack, earthquake type for seismic zone 4.

4.3.2 Before application of paint, all surfaces shall be carefully cleaned of all dirt, moisture, rust, scale, lubricants, and other substances. Lubricants shall be removed by suitable solvents. Rust and scale shall be removed by sandblasting, power sanding, power grinding or power wire brushing.

4.3.3 All steel shall have two or more finish coats of acid resistant ANSI 61 gray paint or electrostatically applied epoxy coating finish.

4.3.4 Paint films which show sags, checks, blisters, teardrops or fat edges will not be accepted.

4.3.5 Battery supporting rails shall be covered with a protective vinyl runner plate not less than 1/16 inch thick.

4.4 Accessories

Each battery shall be furnished with the following accessories:

Flame arrester vents.
Lead coated intercell connectors to provide not less than ½ inch between cells.
Lead coated intertier connectors.
Connector bolts with acid resistant nuts.
Solderless terminal lugs for one 250 MCM copper and one #4 AWG copper cable per polarity.
Cell lifting facility.
Vinyl coated assembly wrenches.
No-Ox-Id grease.
One portable acid electrolyte thermometer.
One portable acid electrolyte hydrometer syringe.
One set of numerals (one numeral per cell) suitable for permanent attachment to cells.

5.0 DRAWING APPROVAL

5.1 GPA shall be allowed one (1) week to review and approve drawings without affecting the shipping date.

5.2 Drawings returned to the Supplier as approved shall be considered authorization to proceed with the work. The approval of GPA shall in no way abrogate the requirements of this specification.

6.0 CERTIFIED REPRODUCIBLES

6.1 At least three (3) weeks prior to shipment of the equipment the Supplier shall furnish GPA with four complete sets of final certified reproducible drawings for each station battery bank purchased. Under no circumstances will "Typical Drawings" be accepted. This includes both schematic and wiring diagrams.

6.2 The following information shall be shown on each drawing submitted:

a. GPA Purchase Order
b. Supplier's Name
c. Description of Drawing

7.0 INSTRUCTION BOOKS

7.1 At least three (3) weeks prior to delivery the Supplier shall furnish GPA five sets of complete operating and instruction books for each station battery bank.

7.2 One additional instruction book shall be attached to each station battery bank.

7.3 Each manual or instruction book shall include the following:

a. Both schematic and wiring drawings. No typical drawings are acceptable.
b. List of parts that were shipped loose from the battery charger and to be installed in the field.
c. A replacement parts list that includes part number identification.
d. A list of recommended spare parts and complete packing lists of accessory items.
e. Instruction manuals covering step-by-step installation and assembly with illustrative drawings. Each separate part shall be marked with or identification system to aid in erection.
f. Manual recommending proper storage procedures.
g. Operating and "troubleshooting" manual.
h. List of all special tools needed for installation and maintenance.

8.0 WARRANTY

The Supplier shall warrant the satisfactory and successful operation of the apparatus furnished under this specification at the rating, under the conditions, and for the service specified. The Supplier shall further warrant the apparatus against defects of design, material and workmanship. All workmanship and parts shall have a warranty of at least 1 year from the date of equipment commissioning.

The Supplier shall supply three sets of prints of the above requirements. In addition, a list indicating the drawing number and title of each drawing shall be provided.

9.0 TEST REPORTS

Four (4) copies of certified test reports shall be supplied to GPA.

GUAM POWER AUTHORITY
P.O. Box 2977
Agana, Guam 96932

TRANSMISSION & DISTRIBUTION SPECIFICATION

Specification No. E-042

For

STATION BATTERY CHARGER

STATION BATTERY CHARGER

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STATION BATTERY CHARGER

1.0 SCOPE

This specification covers the requirements for furnishing of the battery charger and accessories. The battery charger shall provide a precise, regulated DC output and current limiting capabilities that can operate with or without batteries.

2.0 CONFORMANCE TO SPECIFICATION REQUIREMENTS

2.1 Applicable Standards

The station battery bank shall meet the requirements of the IEEE, NEC, ANSI, and the Federal "Occupational Safety and Health Standards" specifications and guidelines including latest revisions with respect to material, design, and tests.

2.2 Deviations and Non-Conformance Requirements

2.2.1 Deviations from this specification or changes in the material or design after the purchase order has been placed must be approved by the Guam Power Authority's Engineering Department and acknowledged by a Purchase Order Amendment.

2.2.2 Units received with deviations or non-conformance, which are not acknowledged as specified in sub-paragraph 2.2.1, are subject to rejection. The supplier of units rejected in this paragraph is responsible for any corrective action including but not limited to materials, labor, and transportation necessary to dispose of, or make the units conform to the specification.

2.2.3 Notification of defective units discovered before or after installation that are believed to be inherent to manufacturing problems or workmanship shall be forwarded to the supplier. The description of the item, documentation of the problem and the desired information, disposition and/or follow-up (as appropriate) that GPA expects from the supplier will be specified. The supplier's response shall be made within thirty (30) days unless otherwise noted or an extension is acknowledged and approved in writing by the Guam Power Authority's Engineering Department.

3.0 DATA TO BE FURNISHED

The following data shall be provided:

3.1. Manufacturer's catalog data with size, type, and factory-configured specification form.

3.2. Physical arrangement drawings with elevation, plan view, and mounting details.

3.3. Wiring schematics and diagrams complete with interconnection requirements and capabilities.

3.4. Outline drawings with dimensions and other physical properties such as weight(s).

3.2 Six (6) complete sets of instruction books containing the following:

a. Instruction and data for ordering of all parts and accessories

b. Instructions covering installation, assembly, operation, and maintenance.

c. Copies of recommended spare parts lists.

4.0 DESIGN AND CONSTRUCTION

4.1 Requirements

4.1.1 Battery charger shall be self-regulating, solid-state silicon controlled full wave rectifier type designed for single operation with the batteries. The charger shall be battery eliminator DC output filtering. Battery charger shall be GNB "GSCR Series Float Battery Charger" Model No. SCRF 130-1-50E or approved equal.

4.1.2 The battery charger shall have an input voltage of 208/240 volt AC, single phase, 60 hertz, 0.75 power factor at full load when tested on battery and resistive load, and 67% efficiency at full load.

4.1.3 The battery charger shall maintain an output regulation of less than 0.5% for simultaneous variations of +10/-12% input voltage, +/-5% input frequency, and 0-100% load capacity.

4.1.4 Solid-state electronic circuits shall have an ac and dc transient voltage protection. The battery charger shall be designed to recharge a totally discharged battery without overloading and trickle rate charge when the battery is fully charged.

4.1.5 Audible noise shall be less than 65dBA at any point 5 feet from any vertical surface of enclosure. Typical values measure shall be 55 to 60dBA at 100% load.

4.2 Capacity

The battery charger should be able to provide a rated output current capacity of 50 Amperes dc continuously at 125 volts dc in an ambient temperature of 104 degrees F (40 degrees C).

4.3 Construction

Battery charger shall be floor mounted (unless otherwise specified) NEMA Type 1 cabinet with a hinged front access door. The enclosure shall be finished painted on the outside and inside with corrosion resistant light gray enamel paint, ANSI Color No. 70, using the manufacturer's standard finish procedure. Cooling system shall not require force ventilation, shall be provided with louvers as required for operation in the specified ambient (except the cabinet top shall be solid). Battery charger cabinet shall be drip shield type.

4.4 Accessories

Standard features are as follows:

AC Input Circuit Breaker
DC Output Circuit Breaker
AC Input Voltmeter, LED Digital
DC Output Ammeter and Voltmeter, LED Digital
Manual Equalizer Timer 0-72 Hours and Float Equalize Indicating Light
AC Power Failure Alarm and Indicating Light
DC Ground Detection Alarm and Indicating Light with Ground & Lamp Tests

High-Low DC Voltage Alarm and Indicating Light
Charger Failure Alarm (No DC Current) and Indicating Light
Battery Discharge Alarm and Indicating Light
End of Discharge Alarm and Indicating Light
DC Current Limit Alarm and Indicating Light
Common (Summary) Alarm and Indicating Light
CASM, Combined Alarm-Status Monitor Board with one (1) Form-C Contacts

- High-Low AC Voltage Alarm Relay
- High DC Voltage Alarm Relay
- Low DC Voltage Alarm Relay
- Ground Detection Alarm Relay
- Charger Failure Alarm Relay
- Common Alarm Relay

High DC Voltage Charger Shutdown Alarm and Indicating Light
Cabinet Heater Strips
Nameplates to identify each item mounted on control panel.

5.0 DRAWING APPROVAL

5.1 GPA shall be allowed one (1) week to review and approve drawings without affecting the shipping date.

5.2 Drawings returned to the Supplier as approved shall be considered authorization to proceed with the work. The approval of GPA shall in no way abrogate the requirements of this specification.

6.0 CERTIFIED REPRODUCIBLES

6.1 At least three (3) weeks prior to shipment of the equipment the Supplier shall furnish GPA with four complete sets of final certified reproducible drawings for each station battery bank purchased. Under no circumstances will "Typical Drawings" be accepted. This includes both schematic and wiring diagrams.

6.2 The following information shall be shown on each drawing submitted:

a. GPA Purchase Order
b. Supplier's Name
c. Description of Drawing

7.0 INSTRUCTION BOOKS

7.1 At least three (3) weeks prior to delivery the Supplier shall furnish GPA five sets of complete operating and instruction books for each station battery bank.

7.2 One additional instruction book shall be attached to each station battery bank.

7.3 Each manual or instruction book shall include the following:

a. Both schematic and wiring drawings. No typical drawings are acceptable.
b. List of parts that were shipped loose from the battery charger and to be installed in the field.
c. A replacement parts list that includes part number identification.
d. A list of recommended spare parts and complete packing lists of accessory items.
e. Instruction manuals covering step-by-step installation and assembly with illustrative drawings. Each separate part shall be marked with or identification system to aid in erection.
f. Manual recommending proper storage procedures.
g. Operating and "troubleshooting" manual.
h. List of all special tools needed for installation and maintenance.

8.0 WARRANTY

The Supplier shall warrant the satisfactory and successful operation of the apparatus furnished under this specification at the rating, under the conditions, and for the service specified. The Supplier shall further warrant the apparatus against defects of design, material and workmanship. All workmanship and parts shall have a warranty of at least 1 year from the date of equipment commissioning.

The Supplier shall supply three sets of prints of the above requirements. In addition, a list indicating the drawing number and title of each drawing shall be provided.

9.0 TEST REPORTS

Four (4) copies of certified test reports shall be supplied to GPA.

TRANSMISSION & DISTRIBUTION SPECIFICATION

Specification No. E-049

For

SUBSTATION POWER TRANSFORMER

OUTDOOR TYPE

115 KV/34.5 KV

80/100/112 MVA

115 KV/34.5 KV
80/100/112 MVA
POWER TRANSFORMER
OUTDOOR TYPE

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1.0 SCOPE

This specification covers GPA's requirements for three-phase power transformer and accessories.

2.0 SERVICE CONDITIONS AND OPERATION

2.1 The power transformer is intended for use in an average ambient temperature of 32 degrees C with corrosive, salt air environment, sustained wind strengths of 170 MPH, and subject to seismic zone 4 condition.

2.2 Transformer will be used for distribution step-down operation.

3.0 CONFORMANCE TO SPECIFICATION REQUIREMENTS

Transformer shall meet the requirements of the following standards and specifications, including latest revisions with respect to material, design and tests.

3.1 Applicable Standards

AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI)

C57.12.00	General Requirements for Liquid-Immersed Distribution, Power and Regulating Transformers
C57.12.90	Test Code for Liquid-Immersed Distribution Power and Regulating Transformers and Guide for Short-Circuit Testing of Distribution and Power Transformers
C76.1 and C76.2	Requirements for Outdoor Bushing

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

TR 1-80	Transformers, Regulators and Reactors

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D92-78	Flash and Fire Points by Cleveland Open Cup
D877-84	Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrode

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

70	National Electrical Code
70B-83	Electrical Equipment Maintenance

UNDERWRITER'S LABORATORIES, INC. (UL)

467-72	Grounding and Bonding Equipment

3.2 Deviation and Non-Conformance Requirements

3.2.1. Deviations from this specification or changes in materials or design after the Purchase Order has been placed must be approved by the GPA Engineering Department and acknowledged by a Purchase Order Amendment.

3.2.2. Units received with deviations or non-conformance which is not acknowledged as specified in Sub-Paragraph 3.2.1 are subject to rejection. The Supplier is responsible for any corrective action including but not limited to materials, labor, and transportation necessary to dispose of, or make the units conform to the specification.

3.2.3. Notification of defects discovered before or after installation that are believed to be inherent to manufacturing problems or workmanship shall be made and forwarded to the Supplier. The description of the item, documentation of the problem and the described information, disposition and/or follow-up (as appropriate) that GPA expects from the Supplier will be specified. The Supplier's response shall be made within thirty (30) days

unless an extension is acknowledged and approved in writing by the GPA Manager of Engineering.

3.3 Warranty

The Supplier shall warrant for 1-year the satisfactory and successful operation of the apparatus furnished under this specification at the rating, under the conditions, and for the service specified. The Supplier shall further warrant the apparatus against defects of design, material and workmanship.

4.0 DATA TO BE FURNISHED

4.1 The Bidder shall provide with his bid the following data:

1. Transformer
   a. Manufacturer _____
   b. Type, Core _____
   c. Windings, Three-winding _____
   d. Service Area, Outdoor _____
   e. Factory Technician Representative on Site _____
   f. Warranty, 1-Year _____
   g. Quantity _____

2. Delivery Date
   a. 8 months ARO or the earliest date _____

3. Rating
   a. Rated Output Capacity, 80/100/112 MVA _____
   b. Number of Phase, 3 _____
   c. Rated Frequency, 60 Hz _____
   d. HV rating and connections, 115 kV/Grounded Wye _____
   e. LV rating and connections, 34.5 kV/Grounded Wye _____
   f. Tertiary rating and connections, 13.8 kV/Delta _____
   g. Vector Group, YNynd1 _____
   h. HV Tap Steps, 5 _____
      HV Tap Voltage, 115 kV +/- 2 x 2.5% _____
   i. LV Tap Steps, 32 _____

LV Tap Voltage, 34.5 kV +/- 16 x 0.625% _____

j. Cooling Class _____

4. High Voltage (HV) Bushings
   a. Manufacturer/ Country _____
   b. Model/ Part No. _____
   c. Voltage Class, 115 kV _____
   d. Minimum BIL, 550 kV _____
   e. Minimum Voltage Creepage, 115 Inches _____

5. High Voltage Neutral (HVN) Bushings
   a. Manufacturer/ Country _____
   b. Model/ Part No. _____
   c. Voltage Class, 15 kV _____
   d. Minimum BIL, 110 kV _____
   e. Minimum Voltage Creepage, 15 Inches _____

6. Low Voltage (LV) Bushings
   a. Manufacturer/ Country _____
   b. Model/ Part No. _____
   c. Voltage Class, 35 kV _____
   d. Minimum BIL, 200 kV _____
   e. Minimum Voltage Creepage, 35 Inches _____

7. Low Voltage Neutral (LVN) Bushing
   a. Manufacturer/ Country _____
   b. Model/ Part No. _____
   c. Voltage Class, 15 kV _____
   d. Minimum BIL, 110 kV _____
   e. Minimum Voltage Creepage, 15 Inches _____

8. Tertiary Voltage (TV) Bushing
   a. Manufacturer/ Country _____
   b. Model/ Part No. _____
   c. Voltage Class, 15 kV _____
   d. Minimum BIL, 110 kV _____
   e. Minimum Voltage Creepage, 15 Inches _____

9. High Voltage (HV) Bushing Current Transformers
   a. Manufacturer/ Country _____

b. Model/ Part No. _____
c. MRCT, 1200/5 _____
d. Class, C800 _____
e. Burden, 100 VA _____

10. High Voltage (HVN) Bushing Current Transformers
a. Manufacturer/ Country _____
b. Model/ Part No. _____
c. MRCT, 1200/5 _____
d. Class, C800 _____
e. Burden, 100 VA _____

11. Low Voltage (LV) Bushing Current Transformers
a. Manufacturer/ Country _____
b. Model/ Part No. _____
c. MRCT, 2000/5 _____
d. Class, C800 _____
e. Burden, 100 VA _____

12. Low Voltage (LVN) Bushing Current Transformers
a. Manufacturer/ Country _____
b. Model/ Part No. _____
c. MRCT, 1200/5 _____
d. Class, C800 _____
e. Burden, 100 VA _____

13. Tertiary Voltage (TV) Bushing Current Transformers
a. Manufacturer/ Country _____
b. Model/ Part No. _____
c. MRCT, 1200/5 _____
d. Class, C800 _____
e. Burden, 100 VA _____

14. Spare Bushings
a. HV Bushings, 2 each _____
b. HVN Bushing, 1 each _____
c. LV Bushings, 2 each _____
d. LVN Bushing, 1 each _____
e. TV Bushing, 1 each _____

15. Guaranteed Efficiency at 100% Power Factor
    a. At 1-1/4 load (125%) _____
    b. At full load (100%) _____
    c. At 3/4 load (75%) _____
    d. At 1 /2 load (50%) _____
    e. At 1/4 load (25%) _____

16. Guaranteed Regulation at 100% Load
    a. At 100% power factor _____
    b. At 80% power factor _____

17. Guaranteed Loss
    a. Total loss at 100% voltage, kW _____
    b. Load loss (P_k) at rated voltage, kW _____
    c. No-load loss (P_o) at rated voltage, kW _____
    d. No-load loss at 110 % voltage, kW _____
    e. Maximum auxiliary power loss, kW _____

18. Guaranteed Exciting Current
    a. At 100% voltage, Amps _____
    b. At 110 % voltage, Amps _____

19. Guaranteed percent impedance, 10% _____

20. Calculated zero-sequence percent impedance, % _____

21. Guaranteed maximum average audible sound level for each stage of cooling
    a. Self-Cooled, dB _____
    b. 1st Stage, dB _____
    c. 2nd Stage, dB _____

22. Forced Cooling
    a. Cooling power requirements, kW _____
    b. Auxiliary power, Volts _____

23. Total Auxiliary Load with cooling, LTC, and cabinet space heaters
    a. Power Requirements (P_{co}) at No-Load Operation, kW _____
    b. Power Requirements (P_{cs}) at Rated Power Operation, kW _____

c. Auxiliary power, Volts _____

24. Type of Oil Preservation System _____

25. Method of mounting radiators
    a. Removable or Integral with the tank _____

26. Shipping data
    a. Shipping weight, Lbs. _____
    b. Shipping dimension (LxWxH), Inches _____
    c. Oil or gas filled _____

27. Transformer Overall Dimension (LxWxH), Inches _____

28. Type of transformer winding material used for all windings
    a. HV windings, COPPER _____
    b. LV windings, COPPER _____

29. No Voltage Tap Changer
    a. Manufacturer/ Country _____
    b. Model/ Part No. _____
    c. Current rating, Amps _____

30. Load Tap Changer
    a. Manufacturer/ Country _____
    b. Model/ Part No. _____
    c. Current rating, Amps _____

31. Automatic Voltage Regulator (AVR)
    a. Manufacturer/ Country, Beckwith Electric/ USA _____
    b. Model/ Part No., M-2001D _____

32. Dissolve Gas Analysis (DGA) or Fault Gas and Moisture Monitor
    a. Manufacturer/ Country, GE USA _____
    b. Model/ Part No., Hydran M2 _____

33. Spare Hydran M2 Sensor 0-2000 ppm
    a. Part No.16270, 2 each _____

34. LTC Filtration System

a. Manufacturer/ Country, Oil Filtration Systems/ USA _____
b. Model/ Part No., LTCFS-6-S514D/2-120-N4-B _____

35. HV Surge Arresters
a. Manufacturer/ Country _____
b. Voltage rating (duty cycle), rms kV _____
c. Max. continuous operating voltage, rms kV _____
d. One second TOV capability, rms kV _____
e. Creepage distance, inches _____
f. Total weight of each unit, lbs. _____

36. LV Surge Arresters
a. Manufacturer/ Country _____
b. Voltage rating (duty cycle), rms kV _____
c. Max. continuous operating voltage, rms kV _____
d. One second TOV capability, rms kV _____
e. Creepage distance, inches _____
f. Total weight of each unit, lbs. _____

37. TV Surge Arresters
a. Manufacturer/ Country _____
b. Voltage rating (duty cycle), rms kV _____
c. Max. continuous operating voltage, rms kV _____
d. One second TOV capability, rms kV _____
e. Creepage distance, inches _____
f. Total weight of each unit, lbs. _____

38. Oil
a. Manufacturer/ Country _____
b. Product, INHIBITED _____
c. Type, ASTM D3487 Type II _____
d. Amount required, Main tank, gals _____
Conservator tank, gal. _____
e. Total weight, Main tank, lbs. _____
Conservator tank, lbs. _____
f. Method of delivery _____

39. Target Type Fault Indicator
a. Manufacturer/ Country, Fuji Electric/ Japan _____

b. Model/Part No., TK Series/ TKL 200-DC12-B _____

40. Anchor Bolts, 1" dia. x 16" L _____

41. Space Heaters at TV Terminal Cabinet _____

42. Attach list of recommended spare parts with quantities.
43. Attach list of special tools.
44. Bidder shall include in his bid the costs for factory witness testing by two (2) GPA representatives.

4.2 An outline drawing shall be provided with each bid quotation. This drawing shall include the following information:

a. Projected floor space of the transformer, including radiators and expansion tanks.
b. Height of transformer from floor level to top of high-voltage bushing.
c. Height of transformer from floor level to top of low-voltage bushing.
d. Height of transformer from floor level to top of tank, and to the highest non-removable part.
e. Weight of core and windings.
f. Weight of tank and radiators.
g. Number of gallons of oil and total weight of the oil.
h. Total weight of the assembled transformer including oil.
i. Power requirements for all control and auxiliary equipment.

4.3 Within ten (10) weeks after award of contract, the successful bidder shall provide the following drawings for GPA approval.

4.3.1 Nameplate drawing including all current transformer ratios.

4.3.2 Outline drawing including the following:

a. Accessories and location
b. Weights with and without oil
c. Shipping center of gravity-shown on two views.
d. Installed center of gravity-shown on two views.
e. Anchoring requirements.

4.3.3 Base drawing including anchor bolt locations, completely detailed and dimension from equipment center lines:

a. Bushing outlines including size of stud, thread size and thread length.
b. Surge arrester outlines.
c. Location of radiators.
d. Location of conservator.
e. Control elementary and wiring diagrams.
f. LTC control elementary and wiring diagrams.
g. Current transformer elementary and wiring diagrams.
h. Current transformer ratio correction factor and secondary excitation curves.

The Supplier shall supply three sets of prints of the above requirements. In addition, a list indicating the drawing number and title of each drawing shall be provided.

4.4 Drawings Approval

4.4.1 GPA shall be allowed three (3) weeks to review and approve drawings provided in Section 4.3 without affecting the shipping date.

4.4.2 Drawings returned to the Supplier as approved shall be considered authorization to proceed with the work. The approval of GPA shall in no way abrogate the requirements of this specification.

4.5 Certified Reproducible

4.5.1 At least three (3) weeks prior to shipment of the equipment the Supplier shall furnish GPA an AutoCAD file and a complete set of final certified reproducible vellum for each transformer purchased. Under no circumstances will "Typical Drawings" be accepted. This includes both schematic and wiring diagrams.

4.5.2 Final certified reproducible shall be submitted on full size, right reading, photographic Mylar. The following information shall be shown on each drawing submitted:

a. GPA Purchase Order

b. Supplier's Name
c. Description of Drawing

4.6 Instruction Books

4.6.1 At least three (3) weeks prior to delivery the Supplier shall furnish GPA five sets of complete operating and instruction books for each transformer.

4.6.2 One additional instruction book shall be attached to each transformer.

4.6.3 Each manual or instruction book shall include the following:

a. Both schematic and wiring drawings. No typical drawings are acceptable.

b. List of parts that were shipped loose from the transformer and to be installed in the field.

c. A replacement parts list that includes part number identification.

d. A list of recommended spare parts and complete packing lists of accessory items.

e. Instruction manuals covering step-by-step installation and assembly with illustrative drawings. Each separate part shall be marked with or identification system to aid in erection.

f. Manual recommending proper storage procedures.

g. Operating and "troubleshooting" manual for the transformer.

h. List of all special tools needed for installation and maintenance.

5.0 RATINGS

5.1 Description

Transformer shall be a 3-phase, oil-immersed, outdoor type unit for use on a 60 hertz effectively grounded system. Transformer windings (primary, secondary, and tertiary) shall be made of COPPER.

5.2 Operations and Environment

The transformer is to be used for step-down operation, in a salt air environment near sea level with ambient temperatures ranging between 75 and 100 degrees F.

5.3 KVA Rating/Temperature Rise

The transformer shall have the following ratings:

Self-Cooled OA	80 MVA
1st stage fans FA	100 MVA
2nd stage fans FOA	112 MVA

The average winding temperature use will not exceed 65 degree C (measured by resistance method) when operated at the OA/FA/FOA rating.

5.4 Voltage Ratings and Phase Displacement

5.4.1 The primary winding (High Voltage) shall be rated 115,000 Y/ 66,395 volts, Grounded Wye connected.

5.4.2 The secondary winding (Low Voltage) shall be rated 34,500 Y/ 19,919 volts, Grounded Wye connected.

5.4.3 The tertiary winding (Tertiary Voltage) shall be rated 13,800 volts, Delta connected.

5.4.4 The phase displacement between the 115,000 volt and 34,500 volt winding shall be 0 electrical degrees with the low voltage lagging the high voltage in a counter-clockwise phase rotation.

The phase displacement between the 115,000 volt and 13,800 volt winding shall be 30 electrical degrees with the tertiary voltage lagging the high voltage in a counter-clockwise phase rotation.

The vector group of the transformer shall be YNynd1.

5.5 Basic Insulation Levels (BIL)

The BIL ratings shall be as tabulated:

High Voltage Winding	550 KV
High Voltage Neutral Winding	110 KV
Low Voltage Winding	200 KV
Low Voltage Neutral Winding	110 KV
Tertiary Voltage Winding	110 KV

5.6 Impedance

The percent impedance voltage for the high to low voltage windings (H-X) shall be 10 percent on the unit's OA rating; impedance shall have tolerances as specified in ANSI Standard C5.12.00.

5.7 Sound Level

The average sound level of transformer shall be of a standard sound level or reduced sound level. Standard sound levels shall not exceed 76/78/80 db based on the transformer rating in accordance with NEMA TR-1-1971 Standards. Reduced sound level transformers shall be 12dB below the standard and shall not exceed the levels for 64/66/68 dB for OA/FA/FA, OA/FA/FOA or OA/FOA/FOA ratings.

The transformer sound level shall be reduced by reducing the flux density of the core.

The Supplier shall state in his quotation the price difference between a standard sound level and a reduced sound level transformer.

5.8 Surge Arresters

Station class metal oxide surge arresters shall be provided.

The Maximum Continuous Operating Voltage rated 90 kV rms shall be 70 kV MCOV for the transformer HV terminals. High voltage arresters shall be mounted on the transformer, ABB type or equal.

The Maximum Continuous Operating Voltage rated 27 kV rms shall be 22 kV

MCOV for the transformer LV terminals. Low voltage arresters shall be mounted on the transformer, ABB type or equal.

The Maximum Continuous Operating Voltage rated 10 kV rms shall be 8.4 kV MCOV for the transformer TV terminals. Tertiary voltage arresters shall be mounted in the TV Terminal Cabinet of the transformer, ABB type or equal.

6.0 CONSTRUCTION

6.1 Bushings

6.1.1. High voltage bushings shall be of the paper and oil "capacitor" TYPE, ANSI Standard Inter-changeable, with visible oil level gauge at the top of each bushing. Each bushing shall be provided with a power factor test tap. Bushing color shall be ANSI 70 light gray. Threaded stud for connection of bushing to cable or straps shall be silver-plated.

6.1.2. Low voltage bushings shall be of the paper and oil "capacitor" TYPE, ANSI Standard Inter-changeable, with visible oil level gauge at the top of each bushing. Each bushing shall be provided with a power factor test tap. Bushing color shall be ANSI 70 light gray. Threaded stud for connection of bushing to cable or straps shall be silver-plated.

6.1.3. Tertiary voltage phase and all neutral bushings shall be of the dry-type, one piece porcelain body, or acceptable condenser type. Threaded stud for connection of bushing to cable or straps shall be silver-plated. The bushing color shall be ANSI 70 light gray.

6.1.4 All bushings minimum creepage distance is 1 inch/ kV. Bushings provided with the transformer shall be in accordance with the following:

BUSHING	VOLTAGE CLASS KV	MINIMUM BIL KV	MINIMUM VOLTAGE CREEPAGE IN	LOCATION
HV Phase	115	550	115	Top Mtd.
LV Phase	35	200	35	Top Mtd.
TV Phase	15	110	15	Cover Mtd.

HV Neutral	15	110	15	Top Mtd.
LV Neutral	15	110	15	Top Mtd.

6.1.5. Two each spare bushing shall be provided for high and low voltage bushings. One each spare bushing shall be provided for tertiary, high voltage neutral, and low voltage neutral bushings.

6.1.6. TV terminal cabinet used for termination of underground power cables to the bushings shall be provided with space heater and cable support. Bushing terminals shall be at least 60-inches from the cable entry at the bottom of the cabinet to avoid stressing the cables when terminated.

6.2 Bushing Current Transformers

6.2.1. Standard multi-ratio current transformers for Authority's use are required as follows:

Each HV Phase Bushing	Two (2) 1200/5 MRCT accuracy C800.
Each LV Phase Bushing	Two (2) 2000/5 MRCT accuracy C800.
Each TV Phase Bushing	Two (2) 1200/5 MRCT accuracy C800.
HV Neutral Bushing	One (1) 1200/5 MRCT accuracy C800.
LV Neutral Bushing	One (1) 1200/5 MRCT accuracy C800

6.2.2. All secondary tap leads (total of five for each CT) shall be brought out of the top or side wall of the transformer through a gas and oil tight compartment and wired to identified circuit shorting terminal blocks in the transformer control cabinet. All connections between CT's and GPA connection points shall be bolted or crimped. No soldered, split or disconnecting lugs shall be used.

6.2.3. All CT circuits shall be terminated into an eight-pole test switch.

6.2.4. The manufacturer shall provide accuracy curves for the current transformers furnished.

6.2.5. Bushing CT Nameplates shall be provided showing connection and ratio for each tap of each current transformer. These nameplates shall be mechanically fastened and located adjacent to GPA's connection terminals.

6.3 Tap Changers

6.3.1 High Voltage De-energized Manual Taps

Externally operated, full KVA capacity, fixed taps shall be provided to regulate the high voltage + 2 1/2 % and + 5 % from the nominal voltage. The high voltage de-energized tap changer shall be operable by a wheel, crank, or lever accessible by an operator standing at ground level. The operating device shall have provisions for padlocking. Each tap position and associated voltage for that tap shall be clearly identified on a tap position nameplate mounted on the transformer wall directly adjacent to the operating device. The nameplate shall state "For De-energized Operation Only".

6.3.2 Low Voltage Automatic Load Tap Changer

1. Location: Low voltage winding
2. Regulating Range: 10 percent above to 10 percent below rated voltage in 16 steps of 5/8 percent in each direction.
3. Rating: Delivered full kVA capacity at all LTC positions and at all combinations of LTC positions.
4. Tap Selector Switch and Mechanism:
    a. Mount in oil-filled compartment separate from main transformer tank.
    b. Maintain physical isolation so it is not necessary to drain oil or break seal of main transformer tank when servicing LTC.
    c. Tank Accessories:
        i. Hinged maintenance door with oil-resistant gasket.
        ii. Drain, filter, and separating valves.
        iii. Magnetic level indicator with low level 125 vdc alarm contacts.
        iv. Breather.
        v. Manhole for inspection of contacts without lowering oil level.
5. Controls:
    a. Type: Automatic, solid state.

b. Features:
   i. Adjustable bandwidth and voltage level.
   ii. High limit/ low limit blocking.
   iii. Line drop compensation.
   iv. Proper operation when operated isolated or in parallel and for real and reactive power flow in both directions through transformer.
   v. Controls for reduction in regulated output voltage of 2-1/2 or 5 percent, either manually at transformer control cabinet or remotely from supervisory control equipment.
   vi. Local and remote LTC control capability.

c. Equipment:
   i. Current transformer for line drop compensation.
   ii. Position indicator with drag hands to indicate maximum travel.
   iii. Limit switches and stops to prevent travel beyond extreme tap position.
   iv. Crank or hand wheel for manual operation during maintenance.
   v. Positioning devices and off-position contacts.
   vi. Operation counter.
   vii. Potentiometer for remote position indication to Control Room. Provide potentiometer with 1, 280 ohms total resistance and 40 ohms resistance with each LTC step.
   viii. Form C dry contacts wired to RTU for lower limit, upper limit, and hung-up alarms.
   ix. Control circuit protective devices.
   x. Control switches for RAISE-LOWER, AUTOMATIC-MANUAL, and LOCAL-REMOTE.
   xi. OFF-Position contact wired to indicating light in main cabinet.
   xii. Remote control switches for RAISE-LOWER, AUTOMATIC-MANUAL, and a Selsyn type indicator for mounting on the Owner's remote Control Panel.

6.4 Drain, Isolating, Vacuum and Filter Valves

A two inch, globe type, combination drain and lower filter valve shall be provided. This valve shall have a built-in 3/8 inch sampling device. A one inch

upper filter valve shall also be provided.

If transformer is designed for vacuum filling, provision shall be made on the top of the tank for a vacuum connection.

Isolating valves and other necessary devices shall be provided to allow ready installation and removal of radiators and drainage of oil from radiators without draining oil from the main tank. Drain, filter, vacuum valves and their hand wheel shall be made of bronze.

6.5 Lifting Facilities

Lifting facilities shall be provided for lifting the cover separately and for lifting the core and coil assembly from the tank using four lifting cables.

Lifting facilities shall also be provided for lifting the complete transformer using four slings. The bearing surface shall be free from sharp edges.

6.6 Jacking Facilities

Jacking facilities shall be located near the extreme ends of the junctions of the transformer segments. Minimum dimensions and clearances for jacking provisions shall be specified on the outline drawing.

6.7 Pulling Facilities

Pulling eyes shall be provided for pulling the transformer along center line.

6.8 Transformer Base

6.8.1 The transformer base shall be designed to permit rolling or skidding of the transformer in any direction. The base shall be designed so that the transformer center of gravity, as normally prepared for shipment, shall not fall outside the base support for a tilt of the base of 15 degrees from the horizontal, with or without oil in the transformer.

6.8.2 The base shall be fabricated with an adequate number of anchor bolt holes designed to put the transformer base in direct contact, shear and tension, with the transformer concrete foundation at all anchor bolt locations.

Anchorage shall be ASTM A-307 anchor bolts 1" dia. x 16" L with heads embedded in concrete with an ultimate compressive strength of 3000 pounds per square inch. Anchor bolts shall be supplied by manufacturer.

6.9 Nameplate

A diagram nameplate shall be furnished and shall be located near eye level above the base of the transformer. The information furnished shall be in accordance with nameplate 1980 American National Standard 057.12.00, Section 5.12. The Supplier shall also stamp on the nameplate the GPA P.O. Number.

6.10 Liquid Thermometer

The transformer shall have top oil gauges with alarm contacts and a 0-1 mA output shall be provided for top oil temperature.

6.11 Liquid Level Indicator

A magnetic liquid level indicator shall indicate the level of the insulating liquid. Two electrically separate, normally open alarm contacts shall be provided to indicate both high and low liquid levels.

A third contact shall be provided to trip for low liquid level. This contact shall be electrically isolated from the alarm contacts and shall be set so that the trip operation is at a lower liquid level than the low level alarm.

6.12 Hot Spot Thermometer

A three-stage hottest spot winding temperature indicator relay shall be provided in each winding. The second stage contacts shall be wired in parallel to an auxiliary relay to obtain two (2) normally open contacts in addition to fan control contacts. A 0-1 mA output shall be provided for winding temperature.

The loss of cooling and over temperature trip and alarm scheme shall contain the items listed below.

a. Auxiliary contacts from second stage of winding temperature relay.

b. Loss of voltage relay (Device 27-1)

c. Timing relay to allow enough time for a source transfer before operation (Device 95)

d. Timing relay with instant transfer auxiliary switch self-resetting, 6-60 minutes, time delay pickup (Device 2-2). The equipment will be used to give an alarm with loss of voltage and high temperature and de-energize the transformer after a set period of time.

e. Auxiliary time delay relay to give alarm upon loss of voltage to pumps and or fans (Device 27-2).

6.13 Sudden Pressure Relay

A sudden pressure relay shall be provided. This relay shall be factory calibrated for the transformer on which the relay is to be used. The relay shall be provided with two electrically separated contacts for alarm and control. The sudden pressure relay shall be provided with an auxiliary lockout relay with hand reset. The auxiliary relay shall have a normally closed contact from the sudden pressure relay shunting the operating coil of the auxiliary lockout relay. The relay shall be suitable for 125 VDC operations. Relay assembly and location shall allow removal with the transformer energized.

6.14 Mechanical Pressure Relief Device

A self-sealing, mechanical pressure relief device shall be located on the cover. The relief device shall be furnished with alarm contacts and a visual operation indicator. The indicator shall be resettable with hot-sticks from ground level without the necessity of de-energizing the transformer.

6.15 Automatic Voltage Regulator (AVR)

Digital tap changer device shall be Beckwith Electric's M-2001D or newer version. The device shall be used to control and monitor the transformer LTC.

AVR and associated devices shall be located in a cabinet inside the control room.

The AVR shall have the following features:
a. Line Drop Compensation by R, X, or Z
b. Harmonic Analysis
c. Sequence of Events Recording

d. Source PT Voltage Input
e. Supports DNP 3.0, Modbus, and IEC 61850 Protocols
f. Tap Position Knowledge
g. LCD Display
h. Transformer Paralleling
i. RS232 and Ethernet Connections

6.16 Fault Gas and Moisture Monitor

Fault gas and moisture monitor shall be GE Power Systems' HYDRAN M2 or newer version. The dissolved gas monitor (DGA) shall be used for continuous and on-line monitoring of moisture and gas-in-oil for the transformer. The DGA shall have the following features:

a. Monitoring capability for H2, CO, C2H2, C2H4, and H2O.
b. Hourly and daily trend with alarm features
c. History logging of Data and Events
d. Dry Contacts for alarms
e. RS232 and Ethernet Connections
f. DNP 3.0 Protocol
g. NEMA 4X Enclosure
h. Analog and Digital Input/Output Card

Two each Hydran M2 sensor, Part No. 16270, shall be provided as spare.

6.17 LTC Transformer Oil Filtration System

The load tap changer filtration system shall be OIL FILTRATION SYSTEMS' LTCFS-6-S514D/2-120-N4-B or newer version. The LTC filtration system shall be used for continuous online filtration of dielectric oil of a load tap changer transformer featuring:

a. High Efficiency Particulate/ Carbon Removal Filter Element, which can remove particles as small as ½ micron in single pass.
b. Water Removal Element, capable of removing up to 0.25 gals of water.
c. Element Plugged Indication.
d. Variable Operation, system can be run continuously or at 1-4 intervals per day via solid state timer.
e. Automatic Safety Shut-Down and Isolation, if a leak is detected.
f. Cabinet Oil Leak Detection device.
g. Stainless Steel Cabinet.
h. Hour meter.

i. Inlet Make-Oil Adder Valve.
j. Flow Sight.
k. Acid Removal Filter.

6.18 Target Type Fault Indicator

The electromagnetic target type fault indicator shall be TK Series, Fuji Electric Ind. Co. Ltd., TKL 200-DC12-B or approved equal. The fault indicator shall have combinations of contacts that are utilized for output, a plug-in type indicating element with visible indication plate, and manual resetting. The indicators shall be installed inside the transformer control cabinet visible through window glass.

6.19 Core Ground

It is preferred that the core ground connection be above the oil and accessible from a manhole to facilitate testing of the core to tank insulation without lowering the oil. The connector shall be the slotted type with a captive nut connection. The location of core ground should be indicated on the transformer outline drawing.

6.20 Auxiliary Power Source

The auxiliary power will be single-phase 120/240 volt, 60 HZ A/C. The Supplier shall design the transformer cooling system including fans and pumps, LTC motor, controls and accessories to operate on both voltages. The Supplier shall inform GPA of the power requirements needed at the transformer. The terminals provided by the Supplier shall be adequate to receive GPA furnished A/C service conductors.

A 120 VAC, 15 ampere convenience outlet with ground fault protection shall be provided.

Provisions shall be made for an ungrounded 125 VDC incoming supply. All tripping, alarm, and associated devices shall be rated 125 VDC operations.

6.21 Centralized Termination and Control Devices Requirement

All equipment alarms, controls, protection and current transformers shall be brought to individual identified terminals centralized in a weather-proof control cabinet mounted on the equipment tank at a center of cabinet to base height of 5 feet 6 inches. Oil thermometer gauge, high voltage winding temperature gauge,

and low voltage winding gauge shall also be located inside the weather proof cabinet. Adequate hinged doors shall be provided with weatherproof latching facilities. The latching assemblies shall be operated by handles that can be reached by an operator standing at ground level. Each handle shall have provisions for padlocking and be acceptable for weather-proofing the doors in the closed position.

All meters and instruments which require resetting shall be mounted less than six (6) feet above the base of the transformer.

Alarm contacts shall be electrically separate, open during normal conditions, self-resetting, suitable for closing 5 amperes, carrying 3 amperes continuously, and opening 3 amperes at 125 volts DC.

Control contacts shall be electrically separate, open during normal conditions, self-resetting, suitable for closing 30 amperes, carrying 10 amperes continuously, and opening 3 amperes at 125 volts DC.

All alarm and control contacts shall be individually wired to the Target Type Fault Indicators TK Series. Another new set of alarm and control contacts shall be individually wired to the GPA Customer (RTU and Relay Panels).

6.22 Instrument and Control Wiring

6.22.1 THW or THWN wires used by the Supplier shall be of the machine-tool type with 3/64" polyvinyl chloride insulation rated 600 volts, 90 degree C. Other wires with insulation having characteristics which equal or exceed the above requirements for machine-tool type wire are acceptable. Control wire used by the Supplier shall be suitable for wet and dry location, flame retardant, moisture and heat resistant.

6.22.2 All secondary wire, regardless of type, shall be stranded. Wire shall have adequate current-carrying capacity. No. 12 AWG shall be used for control circuits, #10 for CT circuits and #18 for SCADA indication.

6.22.3 Those portions of any secondary wiring in the control box, or those portions of any secondary or control wiring or cable which pass through conduit, shall not be spliced. However, junction boxes

with terminal blocks as specified above may be used to extend secondary wiring passing through conduits.

6.22.4 Ring-tongue terminals shall be used for secondary wiring. Spade, slotted spade, flanged spade, and hook terminals are not acceptable. Ring-tongue terminals shall be sufficiently strong to prevent their breakage under conditions of vibration inherent in the equipment in which they are installed.

6.22.5 Terminals shall have insulated ferrules whenever the spacing between the terminals, or their projection above or below the terminal board, or both, is such that they can make contact with one another.

6.22.6 All wires for external connection shall be properly identified and terminated at conveniently located, easily accessible terminal blocks. All terminal blocks furnished by the Supplier shall have No. 10 screws. The screws shall be secured directly into the contact strips and not into nuts embedded in the terminals blocks. The contact strips shall have sufficient thickness to assure that torque applied to the No. 10 screws to hold the terminal to the contact strips will not damage the threads in the tapped holes. The screws shall be firmly secured to the blocks and shall be separated by insulated barriers. Terminal blocks with clamp type fittings are not acceptable.

6.22.7 Ring-tongue terminals shall be fastened to the contact strips of terminal blocks with machine screws. Barriers shall separate the contact strips.

All circuits shall be protected by molded case circuit breakers. Breakers are to be ambient compensated. The breaker size, supplier's name and catalog number are to be shown on the drawings.

6.22.8 All control, power, alarm, and auxiliary equipment shall be completely wired at the factory.

6.22.9 Hinge wiring and wiring that will be subjected to bending during maintenance or other operations shall be arranged such that the

bending or twisting will be around the longitudinal axis of the wire.

6.22.10 Wiring shall not be spliced or tapped. All connections shall be made at the device terminals or on terminal blocks.

6.22.11 All future, spare, and unused contacts and devices shall be wired to terminal blocks.

6.22.12 A minimum of ten percent (10%) spare terminal points shall be provided.

6.22.13 All wirings external to enclosure or cabinet shall be in rigid steel conduits.

6.22.14 All wirings from the transformer components to the cabinets, which may require removal for shipment, shall be installed in place and in such a manner that it is only necessary to connect the wires to the cabinets after they are installed on the transformer.

6.22.15 Wiring Format

a. All terminals shall be numbered, and the numbers shall correspond to the numbers on the wiring diagram.

b. All wires shall be identified at their termination points with the opposite end designation identification by labeled plastic sleeves or equal. Identification shall correspond to the lettered device, numbered terminal format of the wiring diagrams.

6.22.16 **System Phase Rotation**

The system phase rotation for the island-wide system is GPA C-B-A or NEMA 1-2-3 and all equipment purchased under this contract shall be wired and connected NEMA 1-2-3. All phase markings shall be NEMA 1-2-3. Instrument and relay arrangement shall be 1-2-3 left to right with neutral relays underneath phase grouping. GPA will make the external connections of the incoming and outgoing lines such that GPA C-B-A is connected to NEMA 1-2-3. Phase markings C-B-A shall be reserved for GPA's use.

7.0 TANK

7.1 The main transformer tank shall be designed to withstand, without permanent deformation, pressures 25 % greater than the maximum operating pressures resulting from the system of oil preservation used. The maximum operating pressures (positive and negative) which the transformer tank is designed to withstand shall be indicated on the nameplate.

7.2 Vacuum Filling

If tank is designed for vacuum filling (essentially full vacuum) radiators and auxiliary compartments such as expansion tanks, when not designed for full vacuum filling, shall be so designated and isolating valves shall be provided.

7.3 Manholes

Provide one or more circular handholes and at least two circular manholes in the transformer top with neoprene or better gasket material and bolted covers. This facility must be of sufficient size to allow removal of bushing CTs and allow entrance of a person into the transformer tank (24-inch minimum manhole).

7.4 Ground Pads

In addition to the surge arrester grounds pads, two ground pads, drilled and tapped for NEMA four-hole (1/2 inch bolts on 1-3/4 inch centers) connectors, shall be installed on diagonally opposite corners of the base. If the base is removable, the two pads shall be installed on the transformer tank wall near the base. Ground pads shall be copper-faced steel, stainless steel, or nonferrous pads brazed or welded to the transformer.

8.0 TRANSFORMER OIL

The Supplier shall furnish an adequate quantity of mineral oil for the first fill of each transformer. Mineral oil shall be ASTM D3487 Type II. All furnished oil shall be INHIBITED with DBPC (Ditertiary Butyl Para-Cresol). The oil shall have the following minimum characteristics:

a. Flash Point: Cleveland Open Cup 132 Degrees C.

b. Fire Point: Cleveland Open Cup 145 Degrees C.
c. Specific Gravity at 60 Degree F: 0.865 to 0.910.
d. Viscosity: Saybolt Universal at 100 Degree F - 55 - 63 sec.
e. Acidity: 0.02 Mg KOH/gm 0.1 max.
f. Pour Point: -40 Degree F.
g. Corrosive Sulfur: None
h. Dielectric Strength (ASTM D877): 26 kV Min.
i. Power Factor at 68 Degree F: 0.0% Max.
j. Interfacial Tension: 40 Dynes/CM.
k. Non-PCB (Polychlorinated Biphenyl) Contaminated: Manufacturer is to mark in a permanent manner that the dielectric fluid is "Non-PCB". Certified test report on residual oil remaining in the transformer after factory testing that indicates that the oil is free of PCB.

9.0 TRANSFORMER COOLING

9.1 Cooling Control

9.1.1 A hot-spot dial type thermometer shall be supplied to indicate the maximum hot-spot temperature of the windings. The instrument shall have adjustable alarm contacts and shall be placed at a convenient location, easily readable from ground level. The two stages of cooling shall be activated by the contacts on the dial type hot-spot thermometer. The contacts for cooling control within the hot-spot temperature device shall be readily accessible. This can be accomplished by providing all temperature device windings, oil, etc., with split removable bezel rings.

9.1.2 A manual-off-automatic selector switch shall be provided for the control of each stage of cooling equipment. In the "Automatic" position, the cooling equipment shall be activated by the temperature control. In the "manual" position the cooling circuit shall be energized. A contact shall be provided to indicate loss of power to cooling circuits for remote alarm purposes. The contact shall be wired to a terminal strip in the control cabinet for GPA's connection. A selector switch shall be provided to allow either cooling stage to be used as the first or preferred system.

9.1.3 Operation of the cooling system shall not be made by motor starting switches. If a capacitor is needed for starting, then the motor shall be capacitor start and run.

9.2 Heat Exchangers

Heat exchangers must have sufficient capacity to prevent a temperature rise in excess of that specified for each rating of the transformer. Due to severe corrosion problems, GPA prefers heat exchangers made of copper tube and copper fin construction. ALUMINUM heat exchangers are NOT ACCEPTABLE. Heat exchangers shall be removable from the main tank without the need to drain oil from the main tank.

9.3 Radiators

No accessories or pipes shall be installed above the radiators for easy installation and removal during maintenance.

Material of radiator:	Cold rolled Steel, SS41, and 1.0mm thickness	
Internal painting:	Coating with Celerol reaction primer	
Surface preparation:	Grit blasting to Sa 2.5 (SVENSK STANDARD SIS 0559081967) ASTM 2200 D IS 1477 PART 1	
Exterior paint:	Hot-Dip Galvanizing as per ISO-1461	60 Microns
	Epoxy Primer	20 Microns
	Epoxy Intermediate Coat	40 Microns
	Polyurethane Top Coat	40 Microns
	Total Thickness	160 Microns

9.4 Cooling Fans

All cooling fans shall be of the low speed type to reduce wind noise levels. Each fan shall be multi-bladed or multi-lobed with one common hub. Fans with more than one hub are not acceptable. Control of the cooling fans shall contain no motor starting switches and shall be plug-in type with an identified separate conductor case ground. Metal to metal ground for fans is not acceptable.

10.0 TESTS

10.1 The Supplier shall make his plant available to GPA representatives to inspect the transformer during construction, testing and/or packaging for shipment. Bidder shall include in his bid the factory acceptance test costs witness by GPA, which

covers airfare, meals, hotel accommodation, and car rental during the entire testing period.

A factory test plan complete with acceptable reading values shall be submitted to GPA for approval. The factory test equipment and test methods used shall conform to the applicable requirements of ANSI, NEMA, ASTM, NFPA, and UL standards. Factory tests will be witnessed by two (2) GPA representatives.

Manufacturer's technical representative shall be on island to verify transformer connections and acceptance tests.

10.2 Five (5) copies of certified test reports shall be supplied for the following tests:

1. Standard Routine Tests shall be performed as listed in the latest revision of ANSI C57.12.00, including Supplement C57.12.00a-1978.
   a. Ratio Tests or TTR on the rated voltage connection and on all tap connections.
   b. Polarity and Phase Relation Tests on the rated voltage connection.
   c. Winding Resistance Measurement shall be performed for each winding. The resistance shall be measured and recorded with hot and cold windings.
   d. Winding Insulation Resistance and Polarization Index (PI) Tests shall be performed for each winding.
   e. Core Insulation Resistance Test shall be measured between the core and ground for duration of 1 minute.
   f. Insulation Power Factor Tests and Winding Capacitance Test shall be performed in accordance with ANSI/IEEE C57.12.90.
2. Dielectric Tests
   a. Lightning Impulse test shall be performed in accordance with ANSI/IEEE C57.12.90. Oscillographic records of the test shall be included in the test reports. The minimum height of each individual tract (at maximum deflection) shall be 30 millimeters. Front of Wave Impulse shall be performed. Test sequence shall consist of reduced full

wave, full chopped wave, and full wave.

b. Low Frequency test shall be performed in accordance with ANSI/IEEE C57.12.90. Test shall be performed on auxiliary devices, control, and current transformer circuits.

c. Partial Discharge (Corona) test at full induced-test voltage level. The measurement shall be less than 500pC at one hour voltage level for 60 minutes. Equipment and general method used shall be in accordance with ANSI/IEEE C57.12.14, C57.12.90, and C57.113.

3. Audible Sound Level test in accordance with NEMA TR-I shall be performed for each stage of cooling.

4. Regulation, Efficiency, and Losses. The regulation of each transformer shall be determined for unity (1.0) and eight-tenths (0.8) power factor lagging.

The efficiency and losses of each transformer shall be determined as indicated in the bid data. The guaranteed efficiency and tested total losses shall include losses in all windings.

Measurement of Impedance Voltage, Excitation Current, and Zero-Phase Sequence Impedance shall also be determined.

5. Bushing Tests
   a. Design Tests. Certification that each type, style, and model bushing furnished has passed the test requirements of ANSI C76.1 shall be furnished.

6. Other Tests
   a. Applied Voltage Test shall be performed to confirm insulation status between windings and between windings and earth. Transformer shall withstand specified voltage during 1 minute.

   b. Induced Voltage Test shall be performed to check the insulation status between turns of windings.

   c. Temperature Rise Tests. Temperature tests will be required to check the temperature rise of windings.

d. Leak Test shall be performed to check leakage or reduction of pressure from welding points. Transformer is filled with oil and applies N2 gas to tank.

e. Dissolved Gas in Oil Analysis Test shall be performed to check the condition of oil and inside of the transformer using DGA equipment.

f. Oil Breakdown Voltage Test shall be performed by gathering oil samples from the main tank, main conservator, and OLTC tank.

g. Dew Point of the air (or gas) in the tank shall be determined just prior to shipment and at the final shipping destination.

10.3 The Supplier shall include the following information in the test report.

a. Winding hot spot temperature rise in degree C over the average winding temperature rise at the 112 MVA, 65 degree C rating.

b. Winding Thermal Time Constant.

c. Type of material used in the primary and secondary winding.

11.0 LOSS EVALUATION

11.1 Each bidder shall submit with his bid the guaranteed average load and no-load losses on each transformer submitted on this bid. Guaranteed load losses shall be provided at the transformer's self-cooled (OA) rating and a reference temperature of 85 degree C (65 degree rise + 20 degree C ambient). The requirements and definitions of ANSI Standard C57.12.00, Sections 5.9 and 9.3, shall apply.

11.2 Guaranteed losses will be evaluated by GPA to determine the equivalent cost for owning and operating each transformer. The value of the transformer no-load and load losses will be determined by GPA at the time of purchase to arrive at the projected Total Cost of Ownership (TCO) as follows:

$TCO = IC + [A \times (P_o + P_{co})] + [B \times (P_k + P_{cs} - P_{co})]$ Where:

P_o = No Load Losses (NLL) in kW

P_{co} = Power Consumption of Cooling Equipment at No Load Operation

P_k = Load Losses (LL) in kW

P_{cs} = Power Consumption of Cooling Equipment at Rated Power Operation

IC = Initial Transformer Cost

$A = t \times C_{n/2} \times (1 - (1/(1+i))^n) / i$

$B = u \times t \times C_{n/2} \times (1 - (1/(1+i))^n) / i$

$u = k^2$

t = Operating Hours per Year **(24 Hours/Day X 365 Days/Year = 8760 Hours)**

i = Discount Rate **(5% Used By GPA for Money Certificates Issued)**

n = Expected Lifetime of the Transformer in Years **(GPA Uses 25 Years)**

$C_{n/2}$ = Is the Cost of energy at the Mid-Life of the Transformer

Note: If Annual increase of energy price is assumed to be constant, $c_{n/2}$ can be calculated using C, j & n

$C_{n/2} = (c + (c \times (1+j)^n)) / 2$

c = Is the Initial Cost of Energy ($0.1007) **(Calculated From the weighted average energy rate from the Revenue Report with Fuel-Non Fuel Data Dec 2017)**

j = Is the Annual Increase of Energy Price (1.0985%) **(Calculated from the Base Rate Increases from 1998 to 2018)**

k = Is the Average Loading of the Transformer During its Lifetime (28%) **(Calculated using data From the GPA Substation Analysis 2018)**

Note: Load Losses = Total Losses – No Load Losses

11.3 The Manufacturer shall test each transformer for load and no-load losses. This test data shall be certified as correct and submitted to the Authority prior to or at the time of shipment.

11.4 The Authority will review and consider actual load and no-load losses for each transformer. In the event that the average evaluated losses for like units exceed the average guaranteed losses, the Manufacturer will be penalized at the above rates for the differences. Load and no-load loss penalties will be assessed independently. Bonuses will not be awarded for actual average losses which are less than guaranteed. In addition, any transformer with no-load losses or total

losses greater than the tolerances indicated in ANSI Standard C57.12.00 shall be rejected by the Authority.

12.0 OIL PRESERVATION SYSTEM

12.1 The transformer shall have a conservator (expansion tank) type oil preservation system.

12.2 There shall be no contact between oil in the expansion tank and air. This shall be accomplished by use of a nitrile air cell (diaphragm not allowed) vented to the outside air. The expansion tank shall be of sufficient volume to operate through an ambient temperature range of minus 35 degree C to plus 50 degree C without causing the low oil level alarm contacts to close at the lower limit and without exceeding the recommended full oil level at the upper limit. A shut-off valve, capable of holding the full head of oil in the expansion tank, shall be provided in the oil line between the expansion tank and the main transformer tank.

13.0 FINISH REQUIREMENTS

All metal surfaces shall be thoroughly cleaned of rust, welding scale, and grease, and shall be treated to effect a bond between the metal and paint which will prevent the formation of rust under the paint. A priming coat shall be applied immediately after the bonding treatment. A final finish shall consist of two coats of paint. The exterior final coat shall be ANSI 70 Gray.

14.0 SHIPPING REQUIREMENTS

14.1 Because of severe transportation conditions, the Supplier shall pay particular attention to the proper packaging and bracing of the apparatus to assure its safe arrival. Manufacturer shall install a tilt monitor prior to shipping and results should be within safe recommendations.

14.2 The Supplier shall prepare all materials and equipment for shipment in such a manner as to protect from damage in transit. All small parts and unit components shall be separately boxed or bundled to prevent galling due to rubbing of one part against another. Each item, box or bundle shall be plainly and individually identifiable for content according to item number, GPA P.O. Number, and Supplier's Identifying Number.

14.3 A complete itemized Bill of Lading, which clearly identifies and inventories each assembly, sub-assembly, carton, package, envelope, etc., shall be furnished and enclosed with each item or items at the time of shipment.

14.4 Openings in the transformer tank or radiators resulting from the removal of parts for shipment shall be identified and securely sealed against the entrance of moisture and foreign materials. Covers shall be of sufficient strength to resist puncture.

14.5 Delivery of transformer shall be to actual jobsite as identified by the Manager of Engineering.

TRANSMISSION & DISTRIBUTION SPECIFICATION

Specification No. E-050

For

GENERATION POWER TRANSFORMER

OUTDOOR TYPE

115 KV/13.8 KV

60/80 MVA

115 KV/13.8 KV
60/80 MVA
POWER TRANSFORMER
OUTDOOR TYPE

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1.0 SCOPE

This specification covers GPA's requirements for three-phase power transformer (Cabras T1, Cabras T2, MEC T8, or MEC T9) and accessories.

2.0 SERVICE CONDITIONS AND OPERATION

2.1 The power transformer is intended for use in an average ambient temperature of 32 degrees C with corrosive, salt air environment, sustained wind strengths of 170 MPH, and subject to seismic zone 4 condition.

2.2 Transformer will be used for distribution step-down operation.

3.0 CONFORMANCE TO SPECIFICATION REQUIREMENTS

Transformer shall meet the requirements of the following standards and specifications, including latest revisions with respect to material, design and tests.

3.1 Applicable Standards

AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI)

C57.12.00	General Requirements for Liquid-Immersed Distribution, Power and Regulating Transformers
C57.12.90	Test Code for Liquid-Immersed Distribution Power and Regulating Transformers and Guide for Short-Circuit Testing of Distribution and Power Transformers
C76.1 and C76.2	Requirements for Outdoor Bushing

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

TR 1-80	Transformers, Regulators and Reactors

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D92-78	Flash and Fire Points by Cleveland Open Cup
D877-84	Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrode

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

70	National Electrical Code
70B-83	Electrical Equipment Maintenance

UNDERWRITER'S LABORATORIES, INC. (UL)

467-72	Grounding and Bonding Equipment

3.2 Deviation and Non-Conformance Requirements

3.2.1. Deviations from this specification or changes in materials or design after the Purchase Order has been placed must be approved by the GPA Engineering Department and acknowledged by a Purchase Order Amendment.

3.2.2. Units received with deviations or non-conformance which is not acknowledged as specified in Sub-Paragraph 3.2.1 are subject to rejection. The Supplier is responsible for any corrective action including but not limited to materials, labor, and transportation necessary to dispose of, or make the units conform to the specification.

3.2.3. Notification of defects discovered before or after installation that are believed to be inherent to manufacturing problems or workmanship shall be made and forwarded to the Supplier. The description of the item, documentation of the problem and the described information, disposition and/or follow-up (as appropriate) that GPA expects from the Supplier will be specified. The Supplier's response shall be made within thirty (30) days

unless an extension is acknowledged and approved in writing by the GPA Manager of Engineering.

3.3 Warranty

The Supplier shall warrant for 1-year the satisfactory and successful operation of the apparatus furnished under this specification at the rating, under the conditions, and for the service specified. The Supplier shall further warrant the apparatus against defects of design, material and workmanship.

4.0 DATA TO BE FURNISHED

4.1 The Bidder shall provide with his bid the following data:

1. Transformer
   a. Manufacturer _____
   b. Type, Core _____
   c. Windings, Two-winding _____
   d. Service Area, Outdoor _____
   e. Factory Technician Representative on Site _____
   f. Warranty, 1-Year _____
   g. Quantity _____

2. Delivery Date
   a. 8 months ARO or the earliest date _____

3. Rating
   a. Rated Output Capacity, 60/80 MVA _____
   b. Number of Phase, 3 _____
   c. Rated Frequency, 60 Hz _____
   d. HV rating and connections, 115 kV/Grounded Wye _____
   e. LV rating and connections, 13.8 kV/Delta _____
   f. Vector Group, Ynd1 _____
   g. HV Tap Steps, 5 _____
      HV Tap Voltage, 115 kV +/- 2 x 2.5% _____
   h. Cooling Class _____

4. High Voltage (HV) Bushings
   a. Manufacturer/ Country _____
   b. Model/ Part No. _____

c. Voltage Class, 115 kV _____
d. Minimum BIL, 550 kV _____
e. Minimum Voltage Creepage, 115 Inches _____

5. High Voltage Neutral (HVN) Bushings
   a. Manufacturer/ Country _____
   b. Model/ Part No. _____
   c. Voltage Class, 15 kV _____
   d. Minimum BIL, 110 kV _____
   e. Minimum Voltage Creepage, 15 Inches _____

6. Low Voltage Neutral (LV) Bushing
   a. Manufacturer/ Country _____
   b. Model/ Part No. _____
   c. Voltage Class, 15 kV _____
   d. Minimum BIL, 110 kV _____
   e. Minimum Voltage Creepage, 15 Inches _____

7. High Voltage (HV) Bushing Current Transformers
   a. Manufacturer/ Country _____
   b. Model/ Part No. _____
   c. MRCT, 600/5 _____
   d. Class, C800 _____
   e. Burden, 100 VA _____

8. High Voltage (HVN) Bushing Current Transformers
   a. Manufacturer/ Country _____
   b. Model/ Part No. _____
   c. MRCT, 1200/5 _____
   d. Class, C800 _____
   e. Burden, 100 VA _____

9. Low Voltage (LV) Bushing Current Transformers
   a. Manufacturer/ Country _____
   b. Model/ Part No. _____
   c. MRCT, 4000/5 _____
   d. Class, C800 _____
   e. Burden, 100 VA _____

10. Spare Bushings
    a. HV Bushings, 2 each _____
    b. HVN Bushing, 1 each _____
    c. LV Bushings, 2 each _____

11. Guaranteed Efficiency at 100% Power Factor
    a. At 1-1/4 load (125%) _____
    b. At full load (100%) _____
    c. At 3/4 load (75%) _____
    d. At 1 /2 load (50%) _____
    e. At 1/4 load (25%) _____

12. Guaranteed Regulation at 100% Load
    a. At 100% power factor _____
    b. At 80% power factor _____

13. Guaranteed Loss
    a. Total loss at 100% voltage, kW _____
    b. Load loss (P_k) at rated voltage, kW _____
    c. No-load loss (P_o) at rated voltage, kW _____
    d. No-load loss at 110 % voltage, kW _____
    e. Maximum auxiliary power loss, kW _____

14. Guaranteed Exciting Current
    a. At 100% voltage, Amps _____
    b. At 110 % voltage, Amps _____

15. Guaranteed percent impedance, 10% _____

16. Calculated zero-sequence percent impedance, % _____

17. Guaranteed maximum average audible sound level for each stage of cooling
    a. Self-Cooled, dB _____
    b. 1st Stage, dB _____

18. Forced Cooling
    a. Cooling power requirements, kW _____
    b. Auxiliary power, Volts _____

19. Total Auxiliary Load with cooling, LTC, and cabinet space heaters
    a. Power Requirements (P_{co}) at No-Load Operation, kW _____
    b. Power Requirements (P_{cs}) at Rated Power Operation, kW _____
    c. Auxiliary power, Volts _____

20. Type of Oil Preservation System _____

21. Method of mounting radiators
    a. Removable or Integral with the tank _____

22. Shipping data
    a. Shipping weight, Lbs. _____
    b. Shipping dimension (LxWxH), Inches _____
    c. Oil or gas filled _____

23. Transformer Overall Dimension (LxWxH), Inches _____

24. Type of transformer winding material used for all windings
    a. HV windings, COPPER _____
    b. LV windings, COPPER _____

25. No Voltage Tap Changer
    a. Manufacturer/ Country _____
    b. Model/ Part No. _____
    c. Current rating, Amps _____

26. Dissolve Gas Analysis (DGA) or Fault Gas and Moisture Monitor
    a. Manufacturer/ Country, GE USA _____
    b. Model/ Part No., Hydran M2 _____

27. Spare Hydran M2 Sensor 0-2000 ppm
    a. Part No.16270, 2 each _____

28. HV Surge Arresters
    a. Manufacturer/ Country _____
    b. Voltage rating (duty cycle), rms kV _____
    c. Max. continuous operating voltage, rms kV _____
    d. One second TOV capability, rms kV _____

e. Creepage distance, inches _____
f. Total weight of each unit, lbs. _____

29. LV Surge Arresters
a. Manufacturer/ Country _____
b. Voltage rating (duty cycle), rms kV _____
c. Max. continuous operating voltage, rms kV _____
d. One second TOV capability, rms kV _____
e. Creepage distance, inches _____
f. Total weight of each unit, lbs. _____

30. Oil
a. Manufacturer/ Country _____
b. Product, INHIBITED _____
c. Type, ASTM D3487 Type II _____
d. Amount required, Main tank, gals _____
Conservator tank, gal. _____
e. Total weight, Main tank, lbs. _____
Conservator tank, lbs. _____
f. Method of delivery _____

31. Target Type Fault Indicator
a. Manufacturer/ Country, Fuji Electric/ Japan _____
b. Model/Part No., TK Series/ TKL 200-DC12-B _____

32. Anchor Bolts, 1" dia. x 16" L _____

33. Attach list of recommended spare parts with quantities.
34. Attach list of special tools.
35. Bidder shall include in his bid the costs for factory witness testing by two (2) GPA representatives.

4.2 An outline drawing shall be provided with each bid quotation. This drawing shall include the following information:

a. Projected floor space of the transformer, including radiators and expansion tanks.
b. Height of transformer from floor level to top of high-voltage bushing.

c. Height of transformer from floor level to top of low-voltage bushing.
d. Height of transformer from floor level to top of tank, and to the highest non-removable part.
e. Weight of core and windings.
f. Weight of tank and radiators.
g. Number of gallons of oil and total weight of the oil.
h. Total weight of the assembled transformer including oil.
i. Power requirements for all control and auxiliary equipment.

4.3 Within ten (10) weeks after award of contract, the successful bidder shall provide the following drawings for GPA approval.

4.3.1 Nameplate drawing including all current transformer ratios.

4.3.2 Outline drawing including the following:

a. Accessories and location
b. Weights with and without oil
c. Shipping center of gravity-shown on two views.
d. Installed center of gravity-shown on two views.
e. Anchoring requirements.

4.3.3 Base drawing including anchor bolt locations, completely detailed and dimension from equipment center lines:

a. Bushing outlines including size of stud, thread size and thread length.
b. Surge arrester outlines.
c. Location of radiators.
d. Location of conservator.
e. Control elementary and wiring diagrams.
f. LTC control elementary and wiring diagrams.
g. Current transformer elementary and wiring diagrams.
h. Current transformer ratio correction factor and secondary excitation curves.

The Supplier shall supply three sets of prints of the above requirements. In addition, a list indicating the drawing number and title of each drawing shall be provided.

4.4 Drawings Approval

4.4.1 GPA shall be allowed three (3) weeks to review and approve drawings provided in Section 4.3 without affecting the shipping date.

4.4.2 Drawings returned to the Supplier as approved shall be considered authorization to proceed with the work. The approval of GPA shall in no way abrogate the requirements of this specification.

4.5 Certified Reproducible

4.5.1 At least three (3) weeks prior to shipment of the equipment the Supplier shall furnish GPA an AutoCAD file and a complete set of final certified reproducible vellum for each transformer purchased. Under no circumstances will "Typical Drawings" be accepted. This includes both schematic and wiring diagrams.

4.5.2 Final certified reproducible shall be submitted on full size, right reading, photographic Mylar. The following information shall be shown on each drawing submitted:

a. GPA Purchase Order
b. Supplier's Name
c. Description of Drawing

4.6 Instruction Books

4.6.1 At least three (3) weeks prior to delivery the Supplier shall furnish GPA five sets of complete operating and instruction books for each transformer.

4.6.2 One additional instruction book shall be attached to each transformer.

4.6.3 Each manual or instruction book shall include the following:

a. Both schematic and wiring drawings. No typical drawings are acceptable.

b. List of parts that were shipped loose from the transformer and to be installed in the field.

c. A replacement parts list that includes part number identification.

d. A list of recommended spare parts and complete packing lists of accessory items.

e. Instruction manuals covering step-by-step installation and assembly with illustrative drawings. Each separate part shall be marked with or identification system to aid in erection.

f. Manual recommending proper storage procedures.

g. Operating and "troubleshooting" manual for the transformer.

h. List of all special tools needed for installation and maintenance.

5.0 RATINGS

5.1 Description

Transformer shall be a 3-phase, oil-immersed, outdoor type unit for use on a 60 hertz effectively grounded system. Transformer windings (primary and secondary) shall be made of COPPER.

5.2 Operations and Environment

The transformer is to be used for step-down operation, in a salt air environment near sea level with ambient temperatures ranging between 75 and 100 degrees F.

5.3 KVA Rating/Temperature Rise

The transformer shall have the following ratings:

Self-Cooled OA	60 MVA
1st stage fans FA	80 MVA

The average winding temperature use will not exceed 65 degree C (measured by resistance method) when operated at the OA/FA rating.

5.4 Voltage Ratings and Phase Displacement

5.4.1 The primary winding (High Voltage) shall be rated 115,000 Y/ 66,395 volts, Grounded Wye connected.

5.4.2 The secondary winding (Low Voltage) shall be rated 13,800 volts, Delta connected.

5.4.3 The phase displacement between the 115,000 volt and 13,800 volt winding shall be 30 electrical degrees with the low voltage lagging the high voltage in a counter-clockwise phase rotation.

The vector group of the transformer shall be Ynd1.

5.5 Basic Insulation Levels (BIL)

The BIL ratings shall be as tabulated:

High Voltage Winding	550 KV
High Voltage Neutral Winding	110 KV
Low Voltage Winding	110 KV

5.6 Impedance

The percent impedance voltage for the high to low voltage windings (H-X) shall be 10 percent on the unit's OA rating; impedance shall have tolerances as specified in ANSI Standard C5.12.00.

5.7 Sound Level

The average sound level of transformer shall be of a standard sound level or reduced sound level. Standard sound levels shall not exceed 72/74 db based on the transformer rating in accordance with NEMA TR-1-1971 Standards. Reduced sound level transformers shall be 12dB below the standard and shall not exceed the levels for 60/62 dB for OA/FA, OA/FA or OA/FOA ratings.

The transformer sound level shall be reduced by reducing the flux density of the core.

The Supplier shall state in his quotation the price difference between a standard sound level and a reduced sound level transformer.

5.8 Surge Arresters

Station class metal oxide surge arresters shall be provided.

The Maximum Continuous Operating Voltage rated 90 kV rms shall be 70 kV MCOV for the transformer HV terminals. High voltage arresters shall be mounted on the transformer, ABB type or equal.

The Maximum Continuous Operating Voltage rated 10 kV rms shall be 8.4 kV MCOV for the transformer LV terminals. Tertiary voltage arresters shall be mounted in the TV Terminal Cabinet of the transformer, ABB type or equal.

6.0 CONSTRUCTION

6.1 Bushings

6.1.1. High voltage bushings shall be of the paper and oil "capacitor" TYPE, ANSI Standard Inter-changeable, with visible oil level gauge at the top of each bushing. Each bushing shall be provided with a power factor test tap. Bushing color shall be ANSI 70 light gray. Threaded stud for connection of bushing to cable or straps shall be silver-plated.

6.1.2 Low voltage phase and all neutral bushings shall be of the dry-type, one piece porcelain body, or acceptable condenser type. Threaded stud for connection of bushing to cable or straps shall be silver-plated. The bushing color shall be ANSI 70 light gray.

6.1.3 All bushings minimum creepage distance is 1 inch/ kV. Bushings provided with the transformer shall be in accordance with the following:

BUSHING	VOLTAGE CLASS KV	MINIMUM BIL KV	MINIMUM VOLTAGE CREEPAGE IN	LOCATION
HV Phase	115	550	115	Top Mtd.
HV Neutral	15	110	15	Top Mtd.

LV Phase	15	110	15	Top Mtd.

6.1.5. Two each spare bushing shall be provided for high and low voltage bushings. One each spare bushing shall be provided for high voltage neutral bushings.

6.2 Bushing Current Transformers

6.2.1. Standard multi-ratio current transformers for Authority's use are required as follows:

Each HV Phase Bushing	Two (2) 600/5 MRCT accuracy C800.
Each HV Neutral Bushing	Two (2) 1200/5 MRCT accuracy C800.
Each LV Phase Bushing	Two (2) 4000/5 MRCT accuracy C800.

6.2.2. All secondary tap leads (total of five for each CT) shall be brought out of the top or side wall of the transformer through a gas and oil tight compartment and wired to identified circuit shorting terminal blocks in the transformer control cabinet. All connections between CT's and GPA connection points shall be bolted or crimped. No soldered, split or disconnecting lugs shall be used.

6.2.3. All CT circuits shall be terminated into an eight-pole test switch.

6.2.4. The manufacturer shall provide accuracy curves for the current transformers furnished.

6.2.5. Bushing CT Nameplates shall be provided showing connection and ratio for each tap of each current transformer. These nameplates shall be mechanically fastened and located adjacent to GPA's connection terminals.

6.3 Tap Changers

6.3.1 High Voltage De-energized Manual Taps

Externally operated, full KVA capacity, fixed taps shall be provided to regulate the high voltage + 2 1/2 % and + 5 % from the nominal voltage. The high voltage de-energized tap changer shall be operable by a wheel,

crank, or lever accessible by an operator standing at ground level. The operating device shall have provisions for padlocking. Each tap position and associated voltage for that tap shall be clearly identified on a tap position nameplate mounted on the transformer wall directly adjacent to the operating device. The nameplate shall state "For De-energized Operation Only".

6.4 Drain, Isolating, Vacuum and Filter Valves

A two inch, globe type, combination drain and lower filter valve shall be provided. This valve shall have a built-in 3/8 inch sampling device. A one inch upper filter valve shall also be provided.

If transformer is designed for vacuum filling, provision shall be made on the top of the tank for a vacuum connection.

Isolating valves and other necessary devices shall be provided to allow ready installation and removal of radiators and drainage of oil from radiators without draining oil from the main tank. Drain, filter, vacuum valves and their hand wheel shall be made of bronze.

6.5 Lifting Facilities

Lifting facilities shall be provided for lifting the cover separately and for lifting the core and coil assembly from the tank using four lifting cables.

Lifting facilities shall also be provided for lifting the complete transformer using four slings. The bearing surface shall be free from sharp edges.

6.6 Jacking Facilities

Jacking facilities shall be located near the extreme ends of the junctions of the transformer segments. Minimum dimensions and clearances for jacking provisions shall be specified on the outline drawing.

6.7 Pulling Facilities

Pulling eyes shall be provided for pulling the transformer along center line.

6.8 Transformer Base

6.8.1 The transformer base shall be designed to permit rolling or skidding of the transformer in any direction. The base shall be designed so that the transformer center of gravity, as normally prepared for shipment, shall not fall outside the base support for a tilt of the base of 15 degrees from the horizontal, with or without oil in the transformer.

6.8.2 The base shall be fabricated with an adequate number of anchor bolt holes designed to put the transformer base in direct contact, shear and tension, with the transformer concrete foundation at all anchor bolt locations.

Anchorage shall be ASTM A-307 anchor bolts 1" dia. x 16" L with heads embedded in concrete with an ultimate compressive strength of 3000 pounds per square inch. Anchor bolts shall be supplied by manufacturer.

6.9 Nameplate

A diagram nameplate shall be furnished and shall be located near eye level above the base of the transformer. The information furnished shall be in accordance with nameplate 1980 American National Standard 057.12.00, Section 5.12. The Supplier shall also stamp on the nameplate the GPA P.O. Number.

6.10 Liquid Thermometer

The transformer shall have top oil gauges with alarm contacts and a 0-1 mA output shall be provided for top oil temperature.

6.11 Liquid Level Indicator

A magnetic liquid level indicator shall indicate the level of the insulating liquid. Two electrically separate, normally open alarm contacts shall be provided to indicate both high and low liquid levels.

A third contact shall be provided to trip for low liquid level. This contact shall be electrically isolated from the alarm contacts and shall be set so that the trip operation is at a lower liquid level than the low level alarm.

6.12 Hot Spot Thermometer

A three-stage hottest spot winding temperature indicator relay shall be provided in each winding. The second stage contacts shall be wired in parallel to an auxiliary relay to obtain two (2) normally open contacts in addition to fan control contacts. A 0-1 mA output shall be provided for winding temperature.

The loss of cooling and over temperature trip and alarm scheme shall contain the items listed below.

a. Auxiliary contacts from second stage of winding temperature relay.

b. Loss of voltage relay (Device 27-1)

c. Timing relay to allow enough time for a source transfer before operation (Device 95)

d. Timing relay with instant transfer auxiliary switch self-resetting, 6-60 minutes, time delay pickup (Device 2-2). The equipment will be used to give an alarm with loss of voltage and high temperature and de-energize the transformer after a set period of time.

e. Auxiliary time delay relay to give alarm upon loss of voltage to pumps and or fans (Device 27-2).

6.13 Sudden Pressure Relay

A sudden pressure relay shall be provided. This relay shall be factory calibrated for the transformer on which the relay is to be used. The relay shall be provided with two electrically separated contacts for alarm and control. The sudden pressure relay shall be provided with an auxiliary lockout relay with hand reset. The auxiliary relay shall have a normally closed contact from the sudden pressure relay shunting the operating coil of the auxiliary lockout relay. The relay shall be suitable for 125 VDC operations. Relay assembly and location shall allow removal with the transformer energized.

6.14 Mechanical Pressure Relief Device

A self-sealing, mechanical pressure relief device shall be located on the cover. The relief device shall be furnished with alarm contacts and a visual operation

indicator. The indicator shall be resettable with hot-sticks from ground level without the necessity of de-energizing the transformer.

6.15 Fault Gas and Moisture Monitor

Fault gas and moisture monitor shall be GE Power Systems' HYDRAN M2 or newer version. The dissolved gas monitor (DGA) shall be used for continuous and on-line monitoring of moisture and gas-in-oil for the transformer. The DGA shall have the following features:

a. Monitoring capability for H2, CO, C2H2, C2H4, and H2O.
b. Hourly and daily trend with alarm features
c. History logging of Data and Events
d. Dry Contacts for alarms
e. RS232 and Ethernet Connections
f. DNP 3.0 Protocol
g. NEMA 4X Enclosure
h. Analog and Digital Input/Output Card

Two each Hydran M2 sensor, Part No. 16270, shall be provided as spare.

6.16 LTC Transformer Oil Filtration System

The load tap changer filtration system shall be OIL FILTRATION SYSTEMS' LTCFS-6-S514D/2-120-N4-B or newer version. The LTC filtration system shall be used for continuous online filtration of dielectric oil of a load tap changer transformer featuring:

a. High Efficiency Particulate/ Carbon Removal Filter Element, which can remove particles as small as ½ micron in single pass.
b. Water Removal Element, capable of removing up to 0.25 gals of water.
c. Element Plugged Indication.
d. Variable Operation, system can be run continuously or at 1-4 intervals per day via solid state timer.
e. Automatic Safety Shut-Down and Isolation, if a leak is detected.
f. Cabinet Oil Leak Detection device.
g. Stainless Steel Cabinet.
h. Hour meter.
i. Inlet Make-Oil Adder Valve.
j. Flow Sight.
k. Acid Removal Filter.

6.17 Target Type Fault Indicator

The electromagnetic target type fault indicator shall be TK Series, Fuji Electric Ind. Co. Ltd., TKL 200-DC12-B or approved equal. The fault indicator shall have combinations of contacts that are utilized for output, a plug-in type indicating element with visible indication plate, and manual resetting. The indicators shall be installed inside the transformer control cabinet visible through window glass.

6.18 Core Ground

It is preferred that the core ground connection be above the oil and accessible from a manhole to facilitate testing of the core to tank insulation without lowering the oil. The connector shall be the slotted type with a captive nut connection. The location of core ground should be indicated on the transformer outline drawing.

6.19 Auxiliary Power Source

The auxiliary power will be single-phase 120/240 volt, 60 HZ A/C. The Supplier shall design the transformer cooling system including fans and pumps, LTC motor, controls and accessories to operate on both voltages. The Supplier shall inform GPA of the power requirements needed at the transformer. The terminals provided by the Supplier shall be adequate to receive GPA furnished A/C service conductors.

A 120 VAC, 15 ampere convenience outlet with ground fault protection shall be provided.

Provisions shall be made for an ungrounded 125 VDC incoming supply. All tripping, alarm, and associated devices shall be rated 125 VDC operations.

6.20 Centralized Termination and Control Devices Requirement

All equipment alarms, controls, protection and current transformers shall be brought to individual identified terminals centralized in a weather-proof control cabinet mounted on the equipment tank at a center of cabinet to base height of 5 feet 6 inches. Oil thermometer gauge, high voltage winding temperature gauge, and low voltage winding gauge shall also be located inside the weather proof cabinet. Adequate hinged doors shall be provided with weatherproof latching facilities. The latching assemblies shall be operated by handles that can be reached by an operator standing at ground level. Each handle shall have provisions for

padlocking and be acceptable for weather-proofing the doors in the closed position.

All meters and instruments which require resetting shall be mounted less than six (6) feet above the base of the transformer.

Alarm contacts shall be electrically separate, open during normal conditions, self-resetting, suitable for closing 5 amperes, carrying 3 amperes continuously, and opening 3 amperes at 125 volts DC.

Control contacts shall be electrically separate, open during normal conditions, self-resetting, suitable for closing 30 amperes, carrying 10 amperes continuously, and opening 3 amperes at 125 volts DC.

All alarm and control contacts shall be individually wired to the Target Type Fault Indicators TK Series. Another new set of alarm and control contacts shall be individually wired to the GPA Customer (RTU and Relay Panels).

6.21 Instrument and Control Wiring

6.22.1 THW or THWN wires used by the Supplier shall be of the machine-tool type with 3/64" polyvinyl chloride insulation rated 600 volts, 90 degree C. Other wires with insulation having characteristics which equal or exceed the above requirements for machine-tool type wire are acceptable. Control wire used by the Supplier shall be suitable for wet and dry location, flame retardant, moisture and heat resistant.

6.22.2 All secondary wire, regardless of type, shall be stranded. Wire shall have adequate current-carrying capacity. No. 12 AWG shall be used for control circuits, #10 for CT circuits and #18 for SCADA indication.

6.22.3 Those portions of any secondary wiring in the control box, or those portions of any secondary or control wiring or cable which pass through conduit, shall not be spliced. However, junction boxes with terminal blocks as specified above may be used to extend secondary wiring passing through conduits.

6.22.4 Ring-tongue terminals shall be used for secondary wiring. Spade, slotted spade, flanged spade, and hook terminals are not acceptable. Ring-tongue terminals shall be sufficiently strong to prevent their breakage under conditions of vibration inherent in the equipment in which they are installed.

6.22.5 Terminals shall have insulated ferrules whenever the spacing between the terminals, or their projection above or below the terminal board, or both, is such that they can make contact with one another.

6.22.6 All wires for external connection shall be properly identified and terminated at conveniently located, easily accessible terminal blocks. All terminal blocks furnished by the Supplier shall have No. 10 screws. The screws shall be secured directly into the contact strips and not into nuts embedded in the terminals blocks. The contact strips shall have sufficient thickness to assure that torque applied to the No. 10 screws to hold the terminal to the contact strips will not damage the threads in the tapped holes. The screws shall be firmly secured to the blocks and shall be separated by insulated barriers. Terminal blocks with clamp type fittings are not acceptable.

6.22.7 Ring-tongue terminals shall be fastened to the contact strips of terminal blocks with machine screws. Barriers shall separate the contact strips.

All circuits shall be protected by molded case circuit breakers. Breakers are to be ambient compensated. The breaker size, supplier's name and catalog number are to be shown on the drawings.

6.22.8 All control, power, alarm, and auxiliary equipment shall be completely wired at the factory.

6.22.9 Hinge wiring and wiring that will be subjected to bending during maintenance or other operations shall be arranged such that the bending or twisting will be around the longitudinal axis of the wire.

6.22.10 Wiring shall not be spliced or tapped. All connections shall be made at the device terminals or on terminal blocks.

6.22.11 All future, spare, and unused contacts and devices shall be wired to terminal blocks.

6.22.12 A minimum of ten percent (10%) spare terminal points shall be provided.

6.22.13 All wirings external to enclosure or cabinet shall be in rigid steel conduits.

6.22.14 All wirings from the transformer components to the cabinets, which may require removal for shipment, shall be installed in place and in such a manner that it is only necessary to connect the wires to the cabinets after they are installed on the transformer.

6.22.15 Wiring Format

a. All terminals shall be numbered, and the numbers shall correspond to the numbers on the wiring diagram.

b. All wires shall be identified at their termination points with the opposite end designation identification by labeled plastic sleeves or equal. Identification shall correspond to the lettered device, numbered terminal format of the wiring diagrams.

6.22.16 **System Phase Rotation**

The system phase rotation for the island-wide system is GPA C-B-A or NEMA 1-2-3 and all equipment purchased under this contract shall be wired and connected NEMA 1-2-3. All phase markings shall be NEMA 1-2-3. Instrument and relay arrangement shall be 1-2-3 left to right with neutral relays underneath phase grouping. GPA will make the external connections of the incoming and outgoing lines such that GPA C-B-A is connected to NEMA 1-2-3. Phase markings C-B-A shall be reserved for GPA's use.

7.0 TANK

7.1 The main transformer tank shall be designed to withstand, without permanent deformation, pressures 25 % greater than the maximum operating pressures resulting from the system of oil preservation used. The maximum operating pressures (positive and negative) which the transformer tank is designed to withstand shall be indicated on the nameplate.

7.2 Vacuum Filling

If tank is designed for vacuum filling (essentially full vacuum) radiators and auxiliary compartments such as expansion tanks, when not designed for full vacuum filling, shall be so designated and isolating valves shall be provided.

7.3 Manholes

Provide one or more circular handholes and at least two circular manholes in the transformer top with neoprene or better gasket material and bolted covers. This facility must be of sufficient size to allow removal of bushing CTs and allow entrance of a person into the transformer tank (24-inch minimum manhole).

7.4 Ground Pads

In addition to the surge arrester grounds pads, two ground pads, drilled and tapped for NEMA four-hole (1/2 inch bolts on 1-3/4 inch centers) connectors, shall be installed on diagonally opposite corners of the base. If the base is removable, the two pads shall be installed on the transformer tank wall near the base. Ground pads shall be copper-faced steel, stainless steel, or nonferrous pads brazed or welded to the transformer.

8.0 TRANSFORMER OIL

The Supplier shall furnish an adequate quantity of mineral oil for the first fill of each transformer. Mineral oil shall be ASTM D3487 Type II. All furnished oil shall be INHIBITED with DBPC (Ditertiary Butyl Para-Cresol). The oil shall have the following minimum characteristics:

a. Flash Point: Cleveland Open Cup 132 Degrees C.
b. Fire Point: Cleveland Open Cup 145 Degrees C.
c. Specific Gravity at 60 Degree F: 0.865 to 0.910.
d. Viscosity: Saybolt Universal at 100 Degree F - 55 - 63 sec.

e. Acidity: 0.02 Mg KOH/gm 0.1 max.
f. Pour Point: -40 Degree F.
g. Corrosive Sulfur: None
h. Dielectric Strength (ASTM D877): 26 kV Min.
i. Power Factor at 68 Degree F: 0.0% Max.
j. Interfacial Tension: 40 Dynes/CM.
k. Non-PCB (Polychlorinated Biphenyl) Contaminated:
Manufacturer is to mark in a permanent manner that the dielectric fluid is "Non-PCB". Certified test report on residual oil remaining in the transformer after factory testing that indicates that the oil is free of PCB.

9.0 TRANSFORMER COOLING

9.1 Cooling Control

9.1.1 A hot-spot dial type thermometer shall be supplied to indicate the maximum hot-spot temperature of the windings. The instrument shall have adjustable alarm contacts and shall be placed at a convenient location, easily readable from ground level. The two stages of cooling shall be activated by the contacts on the dial type hot-spot thermometer. The contacts for cooling control within the hot-spot temperature device shall be readily accessible. This can be accomplished by providing all temperature device windings, oil, etc., with split removable bezel rings.

9.1.2 A manual-off-automatic selector switch shall be provided for the control of each stage of cooling equipment. In the "Automatic" position, the cooling equipment shall be activated by the temperature control. In the "manual" position the cooling circuit shall be energized. A contact shall be provided to indicate loss of power to cooling circuits for remote alarm purposes. The contact shall be wired to a terminal strip in the control cabinet for GPA's connection. A selector switch shall be provided to allow either cooling stage to be used as the first or preferred system.

9.1.3 Operation of the cooling system shall not be made by motor starting switches. If a capacitor is needed for starting, then the motor shall be capacitor start and run.

9.2 Heat Exchangers

Heat exchangers must have sufficient capacity to prevent a temperature rise in excess of that specified for each rating of the transformer. Due to severe corrosion problems, GPA prefers heat exchangers made of copper tube and copper fin construction. ALUMINUM heat exchangers are NOT ACCEPTABLE. Heat exchangers shall be removable from the main tank without the need to drain oil from the main tank.

9.3 Radiators

No accessories or pipes shall be installed above the radiators for easy installation and removal during maintenance.

Material of radiator:	Cold rolled Steel, SS41, and 1.0mm thickness	
Internal painting:	Coating with Celerol reaction primer	
Surface preparation:	Grit blasting to Sa 2.5 (SVENSK STANDARD SIS 0559081967) ASTM 2200 D IS 1477 PART 1	
Exterior paint:	Hot-Dip Galvanizing as per ISO-1461	60 Microns
	Epoxy Primer	20 Microns
	Epoxy Intermediate Coat	40 Microns
	Polyurethane Top Coat	40 Microns
	Total Thickness	160 Microns

9.4 Cooling Fans

All cooling fans shall be of the low speed type to reduce wind noise levels. Each fan shall be multi-bladed or multi-lobed with one common hub. Fans with more than one hub are not acceptable. Control of the cooling fans shall contain no motor starting switches and shall be plug-in type with an identified separate conductor case ground. Metal to metal ground for fans is not acceptable.

10.0 TESTS

10.1 The Supplier shall make his plant available to GPA representatives to inspect the transformer during construction, testing and/or packaging for shipment. Bidder shall include in his bid the factory acceptance test costs witness by GPA, which covers airfare, meals, hotel accommodation, and car rental during the entire testing period.

A factory test plan complete with acceptable reading values shall be submitted to GPA for approval. The factory test equipment and test methods used shall conform to the applicable requirements of ANSI, NEMA, ASTM, NFPA, and UL standards. Factory tests will be witnessed by two (2) GPA representatives.

Manufacturer's technical representative shall be on island to verify transformer connections and acceptance tests.

10.2 Five (5) copies of certified test reports shall be supplied for the following tests:

1. Standard Routine Tests shall be performed as listed in the latest revision of ANSI C57.12.00, including Supplement C57.12.00a-1978.
   a. Ratio Tests or TTR on the rated voltage connection and on all tap connections.
   b. Polarity and Phase Relation Tests on the rated voltage connection.
   c. Winding Resistance Measurement shall be performed for each winding. The resistance shall be measured and recorded with hot and cold windings.
   d. Winding Insulation Resistance and Polarization Index (PI) Tests shall be performed for each winding.
   e. Core Insulation Resistance Test shall be measured between the core and ground for duration of 1 minute.
   f. Insulation Power Factor Tests and Winding Capacitance Test shall be performed in accordance with ANSI/IEEE C57.12.90.
2. Dielectric Tests
   a. Lightning Impulse test shall be performed in accordance with ANSI/IEEE C57.12.90. Oscillographic records of the test shall be included in the test reports. The minimum height of each individual tract (at maximum deflection) shall be 30 millimeters. Front of Wave Impulse shall be performed. Test sequence shall consist of reduced full wave, full chopped wave, and full wave.

b. Low Frequency test shall be performed in accordance with ANSI/IEEE C57.12.90. Test shall be performed on auxiliary devices, control, and current transformer circuits.

c. Partial Discharge (Corona) test at full induced-test voltage level. The measurement shall be less than 500pC at one hour voltage level for 60 minutes. Equipment and general method used shall be in accordance with ANSI/IEEE C57.12.14, C57.12.90, and C57.113.

3. Audible Sound Level test in accordance with NEMA TR-I shall be performed for each stage of cooling.

4. Regulation, Efficiency, and Losses. The regulation of each transformer shall be determined for unity (1.0) and eight-tenths (0.8) power factor lagging.

The efficiency and losses of each transformer shall be determined as indicated in the bid data. The guaranteed efficiency and tested total losses shall include losses in all windings.

Measurement of Impedance Voltage, Excitation Current, and Zero-Phase Sequence Impedance shall also be determined.

5. Bushing Tests
   a. Design Tests. Certification that each type, style, and model bushing furnished has passed the test requirements of ANSI C76.1 shall be furnished.

6. Other Tests
   a. Applied Voltage Test shall be performed to confirm insulation status between windings and between windings and earth. Transformer shall withstand specified voltage during 1 minute.

   b. Induced Voltage Test shall be performed to check the insulation status between turns of windings.

   c. Temperature Rise Tests. Temperature tests will be required to check the temperature rise of windings.

   d. Leak Test shall be performed to check leakage or reduction of pressure

from welding points. Transformer is filled with oil and applies N2 gas to tank.

e. Dissolved Gas in Oil Analysis Test shall be performed to check the condition of oil and inside of the transformer using DGA equipment.

f. Oil Breakdown Voltage Test shall be performed by gathering oil samples from the main tank, main conservator, and OLTC tank.

g. Dew Point of the air (or gas) in the tank shall be determined just prior to shipment and at the final shipping destination.

10.3 The Supplier shall include the following information in the test report.

a. Winding hot spot temperature rise in degree C over the average winding temperature rise at the 80 MVA, 65 degree C rating.

b. Winding Thermal Time Constant.

c. Type of material used in the primary and secondary winding.

11.0 LOSS EVALUATION

11.1 Each bidder shall submit with his bid the guaranteed average load and no-load losses on each transformer submitted on this bid. Guaranteed load losses shall be provided at the transformer's self-cooled (OA) rating and a reference temperature of 85 degree C (65 degree rise + 20 degree C ambient). The requirements and definitions of ANSI Standard C57.12.00, Sections 5.9 and 9.3, shall apply.

11.2 Guaranteed losses will be evaluated by GPA to determine the equivalent cost for owning and operating each transformer. The value of the transformer no-load and load losses will be determined by GPA at the time of purchase to arrive at the projected Total Cost of Ownership (TCO) as follows:

$TCO = IC + [A \times (P_o + P_{co})] + [B \times (P_k + P_{cs} - P_{co})]$ Where:

P_o = No Load Losses (NLL) in kW

P_{co} = Power Consumption of Cooling Equipment at No Load Operation

P_k = Load Losses (LL) in kW

P_{cs} = Power Consumption of Cooling Equipment at Rated Power Operation

IC = Initial Transformer Cost

$A = t \times C_{n/2} \times (1-(1/(1+i))^n)/i$

$B = u \times t \times C_{n/2} \times (1-(1/(1+i))^n)/i$

$u = k^2$

t = Operating Hours per Year **(24 Hours/Day X 365 Days/Year = 8760 Hours)**

i = Discount Rate **(5% Used By GPA for Money Certificates Issued)**

n = Expected Lifetime of the Transformer in Years **(GPA Uses 25 Years)**

$C_{n/2}$ = Is the Cost of energy at the Mid-Life of the Transformer

Note: If Annual increase of energy price is assumed to be constant, $c_{n/2}$ can be calculated using C, j & n

$C_{n/2} = (c+(c \times (1+j)^n))/2$

c = Is the Initial Cost of Energy ($0.1007) **(Calculated From the weighted average energy rate from the Revenue Report with Fuel-Non Fuel Data Dec 2017)**

j = Is the Annual Increase of Energy Price (1.0985%) **(Calculated from the Base Rate Increases from 1998 to 2018)**

k = Is the Average Loading of the Transformer During its Lifetime (66%) **(Calculated using data From the GPA Substation Analysis 2018)**

Note: Load Losses = Total Losses – No Load Losses

11.3 The Manufacturer shall test each transformer for load and no-load losses. This test data shall be certified as correct and submitted to the Authority prior to or at the time of shipment.

11.4 The Authority will review and consider actual load and no-load losses for each transformer. In the event that the average evaluated losses for like units exceed the average guaranteed losses, the Manufacturer will be penalized at the above rates for the differences. Load and no-load loss penalties will be assessed independently. Bonuses will not be awarded for actual average losses which are less than guaranteed. In addition, any transformer with no-load losses or total

losses greater than the tolerances indicated in ANSI Standard C57.12.00 shall be rejected by the Authority.

12.0 OIL PRESERVATION SYSTEM

12.1 The transformer shall have a conservator (expansion tank) type oil preservation system.

12.2 There shall be no contact between oil in the expansion tank and air. This shall be accomplished by use of a nitrile air cell (diaphragm not allowed) vented to the outside air. The expansion tank shall be of sufficient volume to operate through an ambient temperature range of minus 35 degree C to plus 50 degree C without causing the low oil level alarm contacts to close at the lower limit and without exceeding the recommended full oil level at the upper limit. A shut-off valve, capable of holding the full head of oil in the expansion tank, shall be provided in the oil line between the expansion tank and the main transformer tank.

13.0 FINISH REQUIREMENTS

All metal surfaces shall be thoroughly cleaned of rust, welding scale, and grease, and shall be treated to effect a bond between the metal and paint which will prevent the formation of rust under the paint. A priming coat shall be applied immediately after the bonding treatment. A final finish shall consist of two coats of paint. The exterior final coat shall be ANSI 70 Gray.

14.0 SHIPPING REQUIREMENTS

14.1 Because of severe transportation conditions, the Supplier shall pay particular attention to the proper packaging and bracing of the apparatus to assure its safe arrival. Manufacturer shall install a tilt monitor prior to shipping and results should be within safe recommendations.

14.2 The Supplier shall prepare all materials and equipment for shipment in such a manner as to protect from damage in transit. All small parts and unit components shall be separately boxed or bundled to prevent galling due to rubbing of one part against another. Each item, box or bundle shall be plainly and individually identifiable for content according to item number, GPA P.O. Number, and Supplier's Identifying Number.

14.3 A complete itemized Bill of Lading, which clearly identifies and inventories each assembly, sub-assembly, carton, package, envelope, etc., shall be furnished and enclosed with each item or items at the time of shipment.

14.4 Openings in the transformer tank or radiators resulting from the removal of parts for shipment shall be identified and securely sealed against the entrance of moisture and foreign materials. Covers shall be of sufficient strength to resist puncture.

14.5 Delivery of transformer shall be to actual jobsite as identified by the Manager of Engineering.

TRANSMISSION & DISTRIBUTION SPECIFICATION

Specification No. E-051

For

THREE-POLE, GROUP-OPERATED, AIR DISCONNECT SWITCH

SUBSTATION

VERTICAL-BREAK OUTDOOR TYPE

34.5 KV 2000 AMPS
34.5 KV 3000 AMPS
115 KV 1200 AMPS

THREE-POLE, GROUP-OPERATED, AIR DISCONNECT SWITCH
VERTICAL-BREAK, SUBSTATION
OUTDOOR TYPE

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1.0 SCOPE

1.1 This specification covers GPA requirements for 34.5 kV and 115 kV outdoor, three-pole, group-operated, vertical-break, manual or motor operated air disconnect switch. The switch shall be equipped with current-interrupting enhancement to provide a full load-break capability up to 3000 Amperes for 34.5 kV and 1200 Amperes for 115 kV. It shall interrupt line charged currents up to 100A.

The switch shall include arcing horns, insulators, manual or motor operated operators, and other accessories.

1.2 The switch is intended for use in tropical weather conditions with a corrosive sea air atmosphere, with sustained wind strength of 170 MPH and subject to seismic zone 4 condition.

2.0 APPLICABLE PUBLICATIONS

The equipment specified herein shall be designed, manufactured, assembled and tested in accordance with the latest revisions of ANSI C37.30, ANSI 37.32, ANSI 37.33, and ANSI 37.34.

3.0 DEVIATIONS AND NON-CONFORMANCE REQUIREMENTS

3.1 Deviations from this specification or changes in the material or design after the purchase order has been placed must be approved by the GPA Engineering Department and acknowledged by a Purchase Order Amendment issued by GPA.

3.2 Units received with deviations or non-conformances that are not acknowledged per Section 3.1 are subject to rejection. The Supplier of rejected units is responsible for any corrective action including but not limited to materials, labor and transportation necessary to dispose of or make the units conform to the specification.

3.3 Notification of defective units discovered before or after installation that are believed to be inherent to manufacturing problems or workmanship shall be made and forwarded to the Supplier. The description of the item, documentation of the problem and the described information, disposition and/or follow-up (as appropriate) that GPA expects from the Supplier will be specified. The Supplier's

response shall be made within thirty (30) days unless an extension is acknowledged and approved in writing by the GPA Manager of Engineering.

4.0 SUBMITTALS

4.1 Shop drawings indicating details of construction and the outline of all connectors shall be submitted to GPA Engineering for review and approval.

Information required includes:

1. Catalogs and cut sheets.
2. Single-pole assembly:
   a. Dimensions from bottom of base to terminal pads at each end.
   b. Dimensions from bottom of base to tip of blade in open position.
   c. Overall length of base and mounting hole locations.
   d. Terminal pad holes relative to base mounting holes.
3. 3-pole arrangement with material list and mounting dimensions.
4. Detail drawings of the operating mechanism.
5. Show weight of complete single-pole assembly.
6. Show weight of complete 3-pole switch assembly, including operating mechanism.
7. Detail drawings of interrupting attachments.
8. Bill of material.
9. Complete installation instructions.
10. Operation, Maintenance, and Installation Manuals
11. Nameplate

4.2 GPA shall be allowed two (2) weeks to review and approve drawings provided in Section 4.1 without affecting the shipping date. Delays in delivery due to drawings that are disapproved during this review period are the responsibility of the Supplier.

4.3 Drawings returned to the Supplier as approved shall be considered authorization to proceed with the work. The approval of GPA shall in no way abrogate the requirements of this specification.

4.4 Instruction books shall be furnished which shall contain the description of components, parts and accessories, detailed installation instructions, complete instructions covering operation and maintenance of equipment, complete replacement parts list.

4.5 At least one complete set of drawings and instruction books per switch shall be provided at the time of delivery.

4.6 An AutoCAD file and a complete set of final certified reproducible drawings shall be provided to GPA for record and filing. This includes instruction books, schematic diagram, and wiring diagrams.

5.0 CERTIFIED TEST REPORTS

Certified tests shall be conducted in accordance with applicable standards. The Supplier shall furnish two (2) copies of certified test reports for all tests covered by this specification to the GPA Manager of Engineering within two (2) weeks of delivery.

6.0 RATINGS

The switch rating requirements are as follows:

Item	Rating
A. Nominal Voltage	115 kV
B. Maximum Voltage	121 kV
C. Continuous Current Rating, Motor Operated	1,200 A
Manual Operated	1,200 A
D. Momentary Current Rating	100 kA
E. BIL	550 kV
F. Switch Phase Spacing	120 inches
G. Post Insulator	NEMA TR 287

Item	Rating
A. Nominal Voltage	34.5 kV
B. Maximum Voltage	38 kV
C. Continuous Current Rating, Manual Operated	3,000A or 2000A per GPA requisition
D. Momentary Current Rating	100 kA
E. BIL	200 kV
F. Switch Phase Spacing	48 inches
G. Post Insulator	NEMA TR 231

Motor operator dc motor shall be rated for operation at 125 volts dc. Each disconnect switch shall be designed and constructed for operation on a 3-phase, 60 hertz, solidly grounded system, at an ambient temperature range from +40 °C to -30 °C at an altitude below 3,300 feet.

7.0 DESIGN AND CONSTRUCTION

7.1 Switches:

1. Furnish vertical-break configuration, group-operated air disconnect switches equipped with current-interrupting enhancement, which provide full-load break capability (with arcing horns) designed for vertical or horizontal mounting.

2. Do not use cast iron for switches.

3. Do not use nonferrous switch parts above the top insulator caps.

4. Use copper, copper alloy, or aluminum alloy for current carrying parts.

5. Furnish a means of adjustment for correction of misalignment in insulators, bases, and operating linkage without removing switch from structure.

6. Provide counter-balanced main switch blades to prevent them from falling closed or open, from any position, in the event of failure in any link of the operating mechanism.

7. Furnish a complete base properly designed for mounting on steel structures. Switch bases shall be steel channel, hot-dip galvanized after fabrication.

8. Space switches at 4 feet phase spacing for 34.5 kV and 10 feet phase spacing for 115 kV. Provide base mounting for four 5/8 inch mounting bolts spaced on a 9 3/4 x 11 inch pattern per switch.

9. Furnish self-aligning contacts, of high-pressure type of an approved design.

10. Provide self-wiping contacts replaceable in the field without removing the switch from the structure.

11. Furnish flexible leads of suitable ampacity and of noncorrosive material with a clamped and sweated connection for grounding.

12. A lock out/tag out bracket.

13. A grounding lug to accommodate No. 4 to No. 2/O AWG ground wire.

7.2 Insulators:

Furnish station post type, ANSI Color No. 70, Light Gray insulators and with a 5 inch bolt circle assembled by the insulator manufacturer.

7.3 Nameplate

The switch shall be provided with a permanent nameplate showing all of the required information, including the manufacturer's name, month and year of manufacture, and the maximum voltage and current ratings.

8.0 OPERATIONS

8.1 Manual Operating Mechanism:

1. Manual operators shall be heavy-duty geared crank type with gearbox for switches rated 69 kV and above. The hub of the operator handle shall be

located approximately 3 ft. above the structure base plate, unless otherwise indicated in the drawings. Manual operators shall not require an operating force greater than 50 lbs.

2. Provide corrosion-free manual operating mechanism, swing-handle type, with provisions for padlocking in open and closed positions.
3. Provide bracket supports for attaching bearings, operator shaft, and similar items to the steel structures shown on Drawing.
4. Provide a position indicator close to the operating mechanism which clearly shows the position of the switch to be either OPEN or CLOSED.
5. Provide a braided, tinned copper wire grounding strap with a clamp for attaching to the vertical operating shaft and two 9/16-inch holes at the opposite end for attaching to the substation grounding system.
6. Provide a nameplate, including the manufacturer's name, switch type and designation number, serial number, current rating, nominal voltage rating, and BIL voltage rating.
7. Provide sealed, permanently lubricated bearings at each directional offset of the operating linkage.

8.2 Motor Operating Mechanism:

1. Each motor operator shall be complete with a dc motor rated as indicated at the end of the Ratings Specification Data Sheet. Each operator shall have provisions for manual operation without removal or disassembly of the motor operator. The motor operator shall be located such that the hub of the manual operator handle is located approximately 3 feet above the structure base plate, unless otherwise indicated on the drawings. Manual operators shall not require an operating force greater than 50 lb.

2. Motor operators shall have sealed bearings with permanent lubrication.

3. Each operator shall be provided with an auxiliary switch including contacts. Auxiliary switch contacts shall be field convertible.

4. The following accessories shall be furnished for each motor operator:

   - One space heater rated 240 volts ac, single-phase; with thermostat (Applied voltage will be 120 volts ac)

   - One reversing contactor to permit the use of momentarily closed external contacts as initiating devices

- Position indicating target

- Local push-button control

- Local-remote selector switch

- Switch operations counter

5. Each motor operator shall be mounted in a noncorrosion type stainless steel enclosure suitable for protecting the operator during 170 mph wind with driving rain. Painted enclosures are not acceptable.

6. Provisions shall be supplied in the motor operator control circuit for the Owner's external interlock contacts.

7. Motor operator with heavy-duty geared crank type manual operating mechanism and field adjustable auxiliary switch contacts in addition to those required for motor operator control:

   - Minimum number "a" type 16
   - Minimum number "b" type 16

9.0 QUALITY CONTROL

The Supplier shall have a quality control program to ensure compliance with the requirements of this specification. The program shall be documented and available for GPA's review if requested.

Documentation of the quality control program shall indicate where in the production and manufacturing process the quality checks are taken, describe the purpose of the checks, and describe the nature of the check, i.e. if check is visual only or if electrical or mechanical testing is used.

10.0 PACKING AND SHIPPING

10.1 The switch shall be placed and crated with suitable material to prevent damage and injury during shipment and handling operations.

10.2 The switch shall be securely blocked to prevent shifting during transit.

10.3 The Supplier shall have adequate work and inspection instructions for handling, interim storage, preservation, packaging, and shipping to protect the quality of the switch and prevent damage, loss, deterioration and substitution of products.

[INSERT PROJECT NAME]

ENERGY CONVERSION AGREEMENT

BETWEEN

THE GUAM POWER AUTHORITY
(GPA)

AND

[PROJECT COMPANY]

for a

Gas Dual Fired Power Electric Facility

Located at [Insert Location], Guam

2018

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ENERGY CONVERSION AGREEMENT

THIS ENERGY CONVERSION AGREEMENT (the "**Agreement**") is entered into as of this _____ day of _____, 2017 **BETWEEN** the Guam Power Authority, a public corporation and an enterprise fund of the Government of Guam established by the Guam Power Authority Act of 1968 (herein referred to as "**GPA**"), with principal offices located at Gloria B. Nelson Public Service Building 688 Route 15 Fadian, Mangilao, Guam, **AND** [Project Company], a [insert legal name and description] (herein referred to as the "**Project Company**"), with principal offices at [insert address].

RECITALS

WHEREAS, pursuant to the Invitation For Bids issued by GPA on [insert applicable date] (as amended or supplemented), the Project Company has been chosen to develop, design, permit, finance, construct, test, commission, complete, own, insure, operate and maintain an electric power plant (the "Facility", as hereinafter defined) on a build, own and transfer basis at [insert location], Guam, to provide electric power capacity and net energy output to GPA;

WHEREAS, under [the Guam Power Authority Act of 1968] GPA is authorized to enter into contracts whereby it will purchase electric capacity and net energy output from third parties in Guam;

[INSERT WHEREAS CLAUSE REGARDING RELEVANT AND UPDATED PUC APPROVAL ORDER/S]

WHEREAS, the Project Company desires to sell electric capacity and net energy output of the Facility to GPA in accordance with the terms and conditions set forth in this Agreement; and

WHEREAS, GPA is agreeable to purchasing such electric capacity and net energy output from the Project Company in accordance with the terms and conditions set forth in this Agreement.

NOW THIS AGREEMENT WITNESSETH as follows:

[Note: Sections of this ECA and other IFMSB documents which reference Fuel or Fuel related concepts and defined terms such as Heat Rate, Guaranteed Heat Rate, Fuel Charge, etc... are only applicable to Proposals and Facilities that include a Fossil Fuel Fired Component.

ARTICLE 1
DEFINITIONS

Each of the following capitalized terms shall have the meaning set forth below unless a different meaning is expressly attributed to it in the Agreement. All units of measurement used in this Agreement shall conform to the International System of Units (SI).

"**Abandonment**" means a voluntarily cessation by Project Company of the development, construction or operation of the Facility and either (i) the Project Company expressly declares in writing that development, construction or operation of the Facility will not be resumed; or (ii) such cessation continues for 60 consecutive Days, provided that an Abandonment shall not occur if the Project Company is using commercially reasonable and diligent efforts to commence or reinstate development, construction or operation.

"**Actual Heat Rate**" means the Heat Rate expressed in BTU per kWh as determined by Commercial Operation Tests.

"**AGC**" means automatic generation control.

"**Agent**" has the meaning set forth in Article 5.2.

"**Agreement**" or "**ECA**" means this Energy Conversion Agreement, including its Schedules, as amended, supplemented or modified in accordance with the terms and conditions herein.

"**Allowable Total Outages Energy**" has the meaning set forth in Article 9.3.

"**Allowable Forced Outages Energy**" has the meaning set forth in Article 9.3.

"**Annual Average Dependable Capacity**" means for the relevant Contract Year, an amount equal to (a) the sum of the multiplication of each Dependable Capacity (including Initial Dependable Capacity) in effect during such Contract Year by the number of hours that each such Dependable Capacity was in effect during such Contract Year, divided by (b) the number of hours in such Contract Year.

"**Average Dependable Capacity**" means, for the period from the Phase 1 Commercial Operation Date to the end of the first Contract Year, an amount equal to (a) the sum of the multiplication of each Dependable Capacity (including the Initial Dependable Capacity) in effect during the period by the number of hours that each such Dependable Capacity was in effect during the period, divided by (b) the number of hours in the period.

"**Bank**" means the Federal Reserve Bank of the United States of America.

"**Bank Rate**" means the prime interest rate of the Bank from time to time.

"**Bid Date**" means [ ].

"**Bid Guarantee**" means the security established in accordance with the IFMSB to secure inter alia, Project Company's obligations as set forth in this Agreement, during the period between the execution of this Agreement and Financial Close.

"Black Start" means the process of restoring an electric power station to operation without relying on the external transmission network.

"**British Thermal Unit**" or "**Btu**" means the amount of heat required to raise the temperature of one pound of water by one degree Fahrenheit.

"**Business Day**" means any Day (including partial Days) of the Year on which banks are required to be open for business in Guam.

"**Capacity Charge**" has the meaning set forth in Schedule 5.

"**Capacity Damages**" has the meaning set forth in Article 9.3.

"**Cause**" means, in relation to the issuance, renewal, revocation, amendment or modification of any Government Authorization, any default, neglect or failure by Project Company to abide by any Laws of Guam or any of the terms and conditions of any Government Authorization which entitles the relevant Government Authority to revoke, or refuse to issue or renew, the Government Authorization or make an amendment to its terms and conditions.

"**Change in Law**" means any of the following events occurring as result of any action by any Government Authority:

(a) the adoption, imposition, promulgation, coming into effect, modification or repeal of any Law of Guam that affects the Project or Project Company; or

(b) any change in the manner in which a Law of Guam that affects the Project or Project Company is applied or interpreted; or

(c) the imposition by a Government Authority (other than for Cause) of any material condition or delay in connection with the issuance, renewal, or modification of any Government Authorization,

that establishes or results in requirements that affect or relate to the Project that are materially more or less restrictive or materially more or less costly for Project Company.

"**Commercial Operation Date**" or **"COD"** means, for each of Phase 1 and Phase 2, the earlier of (i) the Day following the Day upon which the Phase is Commissioned; or (ii) the Day following the Day upon which the Phase is deemed Commissioned in accordance with Article 8.

"**Commercial Operation Period**" means, with respect to the Facility, the period of time commencing on the Phase 1 COD and ending on (but including) the last day of the Term.

"**Commercial Operation Tests**" mean the tests specified in Schedule 4 to demonstrate that the standard requirements and the guaranteed values (set out in Schedule 4) are met to achieve the COD with respect to each Phase.

"**Commissioned**" means notification by Project Company, accompanied by a report of the GPA Engineer certifying that the tests for Phase 1 or Phase 2, as the case may be, have been satisfactorily completed in accordance with Schedule 4, and that the Facility meets the relevant characteristics set out in Schedule 1 and Schedule 2, provided that upon receipt of such notice and report the date on which each Phase is Commissioned shall be the date upon which the tests for such Phase (as referred to above) have been satisfactorily completed.

"**Commissioning**" means the process by which a Phase is Commissioned.

"**Connection Agreement**" has the meaning set forth in Article 5.5(i).

"**Construction Contract**" means the agreement/s between Project Company and the Construction Contractor/s for the design, engineering, procurement, construction and Commissioning of the Facility, as amended from time to time.

"**Construction Contractor**" means the construction contractor/s that are party to the Construction Contract.

"**Construction Period**" means the period of time commencing on the Construction Start Date and ending on the Phase 2 Commercial Operation Date.

"**Construction Start Date**" means the day on which Project Company issues the first Notice to Proceed to a Construction Contractor.

"**Contracted Characteristics**" means the characteristics of the Facility described in Schedule 2.

"**Contracted Facility Capacity**" means the net electric power generating capacity of the Facility guaranteed to be provided to the Delivery Point on a continuous basis, adjusted to Site Reference

Conditions as set forth in Schedule 2 and to the Fuel being consumed by the Facility at any given time, if applicable.

"**Contracted Phase 1 Capacity**" means the net electric power generating capacity of Phase 1 guaranteed to be provided to the Delivery Point on a continuous basis, adjusted to Site Reference Conditions as set forth in Schedule 2 and to the Fuel being consumed by the Facility at any given time, if appllicable.

"**Contractors**" means the Construction Contractor and the O&M Contractor.

"**Contract Year**" means a period of twelve (12) consecutive months commencing on each consecutive anniversary of the Phase 1 Commercial Operation Date and ending as of the end of the Day preceding the next anniversary of the Phase 1 Commercial Operation Date, except for the first Contract Year which shall start on the Phase 1 Commercial Operation Date.

"**Day**" means a twenty-four (24) hour period beginning and ending at 12:00 midnight Guam time.

"**Declared Capacity**" means the estimated net capacity of the Facility (adjusted to Site Reference Conditions) announced by Project Company pursuant to Article 10.3.

"**Delivery Point**" means the connection point of the Electrical Interconnection Facilities to the 115 kV bus bar at the Facility's switchyard where GPA receives the Net Energy Output from the Project Company, as to be specified in Schedule 2.

"**Dependable Capacity**" means, at any given time, the net capacity of the Facility (excluding any capacity associated with a Renewable Component and any Non-Compliant ESS Capacity) operating on ULSD or Natural Gas if and when applicable, measured in kW (adjusted to Site Reference Conditions), at the Delivery Point of the Facility as determined by the most recent Dependable Capacity Test, provided that for purposes of calculating the Capacity Charge, the Dependable Capacity shall not exceed the Contracted Facility Capacity.

"**Dependable Capacity Test**" has the meaning set forth in Schedule 4 and the frequency described in Article 8.2.

"**Dispatch Instruction**" is an instruction issued directly by the PSCC to Project Company in accordance with (i) the dispatch principles and guidelines established by GPA in accordance with the applicable system grid code for the Grid System; (ii) the Operating Procedures; (iii) the Technical Limits; (iv) Prudent Utility Practices; and this Agreement.

"**Dispute**" means any dispute or disagreement of any kind whatsoever between GPA and Project Company in connection with or arising out of this Agreement.

"**Dollars**" or "**USD**" or "**US$**" all mean the lawful currency of the United States of America.

"**Early Transfer Price**" means the applicable price set forth in Schedule 10 for the purchase of the Facility by GPA from Project Company pursuant to Article 5.5 (e), as the case may be.

"**Electrical Interconnection Facilities**" means all of the electrical interconnection facilities and equipment described in Schedule 1 to be constructed by the Project Company and transferred to GPA at the Phase 1 Commercial Operation Date.

"**Emergency**" means a condition or situation that in the reasonable opinion of GPA poses an imminent threat of (a) materially adversely affecting the ability of GPA to maintain safe, adequate

and continuous electrical service to its customers, having due regard to the then current standard of electrical energy provided to its customers; or (b) endangering the safety of people, plant, or equipment.

"**Energy Charge**" has the meaning set forth in Schedule 5.

"**Environmental Attributes**" means (a) credits, benefits, reductions, offsets and other beneficial allowances, howsoever named or referred to, with respect to any and all fuel, emissions, air quality, or other environmental characteristics, resulting from the use of Facility generation or the avoidance of the emission of any gas, chemical or other substance into the air, soil or water attributable to the sale of energy generated by the Project during the Term and in which Project Company has property rights or will have property rights upon such attributes coming into existence, and include any of the same arising out of legislation or regulation (i) concerned with (A) oxides of nitrogen, sulfur, or carbon, (B) particulate matter, soot, or mercury, or (C) implementing the United Nations Framework Convention on Climate Change (the "**UNFCCC**") or protocols connected to the UNFCCC or crediting "early action" with a view thereto, and (b) all Environmental Attribute Reporting Rights.

"**Environmental Attribute Reporting Rights**" means the rights to report the ownership of any Environmental Attribute, including those rights accruing under any emissions trading program.

"**Equity Documents**" means any agreements relating to the issuance, subscription, placement or underwriting of Shares or other securities convertible into Shares issued by Project Company and any instruments constituting or evidencing Shares or other securities convertible into Shares issued by Project Company, and any documents or agreements evidencing or relating to indebtedness for money borrowed by Project Company from the Investors or their affiliates which, by its terms, is subordinated to any indebtedness for borrowed money incurred by Project Company under any Financing Document.

"ESS" means an energy storage system that meets the requirements set forth in the IFMSB.

"ESS-Related Capacity" means the portion of Dependable Capacity which (i) is expected to be available for dispatch solely because the Facility's ESS is expected to meet the spinning reserve requirement (as set forth in the IFMSB) corresponding to such capacity, and (ii) was assumed to be available for dispatch in the Evaluation Model due to the expectation that the Facility's ESS would offset the spinning reserve requirement (as wet forth in the IFMSB) corresponding to such capacity.

"**Excess Energy**" means, for a hybrid Facility, any energy that can be made available by the Facility, for any given hour, in excess of the energy that can be generated by the Facility operating at 100% of Dependable Capacity due to the spare capacity of the Fossil Fuel Fired Component that is available during the periods when the Renewable Component is capable of generating rernewable energy.

"**Excess Energy Output**" means any Excess Energy which is dispatched by the PSCC under a Dispatch Instruction and is subsequently delivered by the Facility to the Delivery Point.

"Excessive Forced Outages Energy" has the meaning set forth in Article 9.3.

"Excessive Total Outages Energy" has the meaning set forth in Article 9.3.

"**Excusable Event**" means events or circumstances constituting a Change in Law or Force Majeure event occurring after the date of this Agreement and prior to Financial Close that prevents Project Company from performing its obligations under this Agreement.

"**Expected Phase 1 Commercial Operation Date**" means [insert applicable date].

"**Facility**" means an electric generating facility with an expected continuously available fully dispatchable capacity of [ ]MW net (when operating on ULSD if the Facility operates on fossil fuel) to be constructed by Project Company at a leased Site in Guam, whether completed or at any stage of development and construction, including, without limitation or regard to the level of development, the leased land, buildings, engineering and design documents, all power producing equipment and auxiliary equipment including Black Start capability, Fuel handling and storage infrastructures, water intakes and discharges, water treatment and pumping facilities, solid waste disposal facilities, main and plant transformers, plant switchgear, and all other installations as described in Schedule 1.

"Facility Transfer" has the meaning set forth in Article 18.1.

"FERC" means the U.S. Federal Energy Regulatory Commission.

"Final Major Overhaul" has the meaning set forth in Article 18.2.

"**Financial Close**" means the date on which all conditions of the Lenders under the Financing Documents have been met or waived (in accordance with the terms thereof), and initial financing disbursements can take place (as certified by the Agent in writing).

"**Financing Documents**" means the loan agreements, notes, bonds, note or bond purchase agreements, participation agreements, indentures, security agreements, hedging agreements, guarantees, shareholder support agreements, the Lenders' Direct Agreements and other documents relating to the construction and permanent financing (including refinancing) of the Facility or any part thereof provided by any Lender, but excluding any Equity Documents.

"**First Fill**" has the meaning set forth in Article 4.3.2.

"**Fixed Operation and Maintenance Charge**" has the meaning set forth in Schedule 5.

"**Force Majeure**" has the meaning set forth in Article 17.

"**Force Majeure Transfer Price**" means the applicable price set forth in Schedule 10 for the purchase of the Facility by GPA from Project Company pursuant to Article 5.5(g).

"**Forced Outage**" means a failure to make available the Dependable Capacity:

(a) that is not the result of a request by GPA in accordance with this Agreement;

(b) that is not the result of a Scheduled Outage or a Maintenance Outage;

(c) that is not the result of an event or occurrence of a Force Majeure;

(d) that is not the result of a condition caused by GPA or by the Grid System, provided that such condition would not have occurred without the action or inaction of GPA or the condition of the Grid System; or

(f) that does not occur during any period during which the Facility is deemed to provide the Dependable Capacity under Article 8.

"Forced Outages Energy" has the meaning set forth in Article 9.3.

"Fossil Fuel Fired Component" means, for a hybrid plant, the part of the Facility which utilizes Reciprocating Engine Generators or Combustion Turbine Generators.

"Fossil Fuel Fired Net Energy Output" means the portion of the Net Energy Output generated by the Fossil Fuel Fired Component and equal, for any time interval, to the Net Energy Output minus Renewable Net Energy Output.

"**Fuel**" means fuel used by the Facility, which will be ULSD (as specified in Schedule 7) or Natural Gas (as specified in Schedule 9).

"**Fuel Delivery Point**" has the meaning set forth in Schedule 1.

"**Fuel Price (FP)**" has the meaning set forth in Schedule 5.

"**Fuel Supply Requirement**" has the meaning set forth in Article 4.3.1(a).

"**Functional Specifications**" or "**Specification**" means the characteristics (adjusted to Site Reference Conditions) for the design, construction and operation of the Facility, as set forth in Schedule 1.

"**Government**" means the Government of Guam and the Government of the United States, as applicable.

"**Government Authority**" means the Government and/or any national or local governmental authority of Guam with jurisdiction over Project Company, the Project or any part thereof, and/or any department, regulatory, supervisory or competent authority, or political subdivision or instrumentality, agency or judicial body of the Government, or any national or local governmental authority of the Government and/or any person under the direct or indirect control of any of the foregoing.

"**Government Authorizations**" means all formal written permits, licenses, authorizations, consents, decrees, waivers, privileges, approvals and filings required to be obtained from or provided by any Government Authority for the execution, delivery and performance of this Agreement, any other Project Agreement or any Financing Document, including without limitation the design, development, construction, financing, ownership, maintenance and operation of the Facility (and all other activities incidental thereto), as contemplated by this Agreement, the other Project Agreements and the Financing Documents.

"**GPA**" has the meaning set forth in the Preamble hereto.

"**GPA Default Transfer Price**" means the applicable price set forth in Schedule 10 for the purchase of the Facility by GPA from Project Company pursuant to Article 5.5 (d), as the case may be.

"**GPA Engineer**" means the engineering company selected by GPA, the costs of whose appointment and retention shall be paid by GPA.

"**GPA Event of Default**" has the meaning set forth in Article 5.3.

"**Grid System**" means the transmission and distribution facilities through which the Net Energy Output may be transmitted and distributed to users.

"**Guaranteed Heat Rate**" or "**GHR**" means the Heat Rate (at the Site Reference Conditions) guaranteed by the Project Company for the Fossil Fuel Fired Component, for Phase 1 and Phase 2, as set forth in the tables included in Schedule 5.

"**Guam**" or "**Territory of Guam**" means that certain unincorporated and organized territory of the United States in Micronesia.

"**Heat Rate**" expressed in Btu per kWh, means the fuel energy consumption expressed in Btu (higher heating value) required to generate one kWh by the Fossil Fuel Fired Component at the high voltage bushings of the main power transformers.

"**ICC Rules**" means the Rules of Arbitration of the International Chamber of Commerce.

"**IFMSB**" means the invitation for bids issued by GPA on [...] and including all updates and amendments thereto between the date of its submission and the date of this Agreement.

"**Independent Engineer**" means a qualified, international, and independent engineering firm selected by Project Company and approved by GPA for purposes of certifying any claim by Project Company that the Facility should be deemed Commissioned in accordance with Article 8.5.

"**Independent Expert**" has the meaning set forth in Article 18.4.

"**Initial Dependable Capacity**" means, at the Commercial Operation Date for Phase 1 or Phase 2, as the case may be, the capacity set upon successful completion of the Dependable Capacity Test for such Phase and used to establish its respective Commercial Operation Date, which is the maximum capacity adjusted for Site Reference Conditions that the Facility is demonstrated to be capable of delivering continuously at the Delivery Point at that time, in accordance with (and subject to) Article 8.1(d)(iii) and is the capacity to apply until the next Dependable Capacity Test occurs after the Phase 2 Commercial Operation Date.

"**Initial Shareholders**" means [ ].

"**Investor**" means a shareholder of Project Company

"**Invoice Due Date**" has the meaning set forth in Article 14.4.

"**Joint Coordinating Committee**" is the committee established by Project Company and GPA pursuant to Article 11.

"**kW**" means kilowatts.

"**kWh**" means kilowatt-hours.

"**Law**" or "**Laws**" means the laws of Guam and the United States of America.

"**Land Lease Agreement**" or "**LLA**" means the agreement entered into by and between Project Company and GPA whereby Project Company will lease the site on which the Facility shall be built.

"**Lenders**" means the lenders, guarantors, credit providers, multilateral agencies, export credit agencies or other financial institutions or insurers providing (or supporting) the financing or refinancing arrangements for the Project pursuant to the Financing Documents, but not including any Investor or affiliate of an Investor with respect to indebtedness for money borrowed by Project Company from any such Investor or affiliate.

"**Lenders' Direct Agreement**" means the agreement entered into by the Project Company, GPA, and the Lenders and/or their security agent on [ ].

"**Liquidated Damages Due Date**" has the meaning set forth in Article 9.7.

"**Liquidated Damages Notice**" has the meaning set forth in Article 9.7.

"**Loss**" means any loss, cost, expense damage, liability, payment or obligation (including reasonable legal fees and expenses but excluding any indirect or consequential loss, cost, expense, damage, liability, payment or obligation or any loss of revenue or loss of profit).

"**Maintenance Outage**" means an interruption or reduction of the generating capability of the Facility that:

(a) is not a Scheduled Outage;

(b) has been scheduled in accordance with Article 10.4(f); and

(c) is for the purpose of performing work on specific components of the Facility which work should not, in the reasonable judgment of Project Company, be postponed until the next Scheduled Outage.

"**Major Overhaul**" means the repair and reconditioning of any Unit of the Facility that is conducted in accordance with Article 10.4(g) and Schedule 2.

"Maximum Natural Gas Switch Quantity" has the meaning set forth in Article 8.2(f).

"**Metering System**" means the measurement system capable of interpreting readings of all pertinent parameters required by the invoicing process.

"**Million Btu**" or "**MMBtu**" means 10^6 Btu.

"**Month**" means a month according to the Gregorian Calendar, and "**Monthly**" shall be construed accordingly.

"**MW**" means megawatts.

"**MWh**" means megawatt hours.

"**Natural Gas**" means natural gas meeting the Fuel specifications contained in Schedule 9.

"**Net Energy Output**" means the energy output delivered by the Facility and accepted by GPA during a given period of time measured in kWh by the Metering System at the Delivery Point (including Excess Energy Output).

"NERC" means North American Electric Reliablity Corporation.

"Non-Compliant ESS-Related Capacity" means (for any given hour) any portion of the ESS-Related Capacity that is not available to offset the Facility's spinning reserve requirement (as such requirement is set forth in the IFMSB).

"**Notice**" has the meaning set forth in Article 22.

"**Notice of Intent to Terminate**" has the meaning set forth in Article 5.5(a).

"**Notice to Proceed**" means the initial notice to the Construction Contractor to commence engineering, procurement or construction work pursuant to the Construction Contract.

"**O&M Contract**" means any agreement entered into between Project Company and a third party contractor for the operation and maintenance of the Facility.

"**O&M Contractor**" means the party to any O&M Contract which is responsible for the operation and maintenance of the Facility.

"**Operating Procedures**" means the operating procedures developed by the Parties pursuant to Articles 7.4 and 10.2 and in compliance with the applicable system grid code, as such procedures may be modified from time to time in accordance with Article 7.4 and the applicable system grid code.

"**Outage Hours**" means for each month during the Commercial Operation Period, the total number of full load equivalent hours during such month in which Dependable Capacity is reduced due to Forced Outages, Maintenance Outages and Scheduled Outages which shall be calculated as the summation of the duration of each such outage in the month (in hours) multiplied by the reduction in Dependable Capacity during such outage (in MW) divided by the Dependable Capacity (in MW).

"**Party or Parties**" means GPA and Project Company, either individually or collectively.

"**Performance Bond**" means the security established in accordance with Article 9.6(d) to secure the Project Company's ability to pay liquidated damages in accordance with Article 9.

"**Period of Testing**" means, with respect to each Phase, the period from initial synchronization of a Unit or Facility to the Commercial Operation Date for such Phase, during which period testing occurs and net power is produced.

"**Phase**" means either Phase 1 or Phase 2, or both, as the context indicates.

"**Phase 1**" means all work as required to put the Simple Cycle Unit in case of a combined cycle Facility or full firm base load capacity in case of other technologies into commercial operation.

"**Phase 1 Commercial Operation Date**" means the Commercial Operation Date for Phase 1.

"**Phase 2**" means all work as required to put the entire facility into commercial operation.

"**Phase 2 Commercial Operation Date**" means the Commercial Operation Date for Phase 2.

"**Power System Control Center**" or "**PSCC**" means GPA's main control center located at [ ] or such other control center designated by GPA from time to time (but not more than one center at a time) which shall issue Dispatch Instructions to Project Company.

"**Pre-Existing Site Condition**" means any artificial obstructions on, under, in, or affecting the Site or any contamination that could not have been discovered by an experienced international engineering and construction contractor using the most sophisticated devices and personnel available at the time of Site investigation by such contractor but shall not, for the avoidance of doubt, include archaeological discoveries on the Site.

"**Pre-Existing Site Condition Period**" means the period from the date of this Agreement to the date falling 12 months after the issuance of Notice to Proceed under the Construction Contract.

"**Price**" means the price of electricity charged by Project Company to GPA and calculated in accordance with the formulas in Schedule 5.

"**Project**" means the development, design, engineering, financing, refinancing, insurance, procurement, construction, startup, testing, Commissioning, completion, ownership, operation and maintenance of the Facility, all activities incidental thereto, and the Facility itself.

"**Project Agreements**" means collectively, the Energy Conversion Agreement, Land Lease Agreement, O&M Contract (if applicable), Construction Contract, and any other document, contract, or agreement executed subsequent to the date hereof by Project Company that is relevant to the construction and development of the Project or the ownership or management of Project Company (other than any Financing Document, Equity Document or Government Authorization) or otherwise mutually agreed in writing to constitute a "Project Agreement".

"**Project Company**" has the meaning set forth in the Preamble hereto.

"**Project Company Default Transfer Price**" means the applicable price set forth in Schedule 10 for the purchase of the Facility by GPA from Project Company pursuant to Article 5.5(f).

"**Project Company Event of Default**" has the meaning set forth in Article 5.2.

"**Prolonged Force Majeure**" means a condition in which a Force Majeure event has caused 50% or more of the Contracted Facility Capacity to be unavailable for dispatch for eighteen (18) consecutive months or more and is continuing.

"**Proposal**" means Project Company's written offer and amendments based on the covenants, terms and conditions as contained in the IFMSB for the development, financing, construction, ownership, operation and transfer of the Project.

"**Prudent Utility Practices**" means those practices, methods, techniques and standards, as changed from time to time, that are generally accepted internationally for use in electric utility industries (taking into account conditions in Guam), and commonly used in prudent engineering and operation to design, engineer, construct, test, operate and maintain equipment lawfully, safely and economically as applicable to power stations of the size, service, and type (and operating with the contemplated Fuels) as the Facility.

"**PUC**" means the Public Utilities Commission of Guam.

"**Remedial Actions**" has the meaning set forth in Article 9.2.

"Renewable Component" means, for a hybrid plant, the part of the Facility which utilizes solar or wind power generation technology.

“Renewable Component Degradation Guarantee” means the Bidder’s guaranteed rate of degradation for the Renewable Component as provided in Table 15.1 of Section D.

“Renewable Net Energy Output” means the portion of the Net Energy Output generated by the Renewable Component.

"**Required Phase 1 Commercial Operation Date**" means, with respect to Phase 1, the date falling 20 months from Financial Close, or such later date as may apply in accordance with the provisions of this Agreement.

"**Required Phase 2 Commercial Operation Date**" means, with respect to Phase 2, the date falling 30 months from Financial Close, or such later date as may apply in accordance with the provisions of this Agreement.

"**Required Financial Closing Date**" means March 23, 2020, as such date may be extended for up to ninety (90) Days in accordance with Article 9.6(b) of this Agreement.

"**Scheduled Outage**" is a planned interruption of the generating capability of the Facility that:

(a) is not a Maintenance Outage;

(b) has been scheduled in accordance with Article 10; and

(c) is for inspection, testing, Major Overhauls, preventive and corrective maintenance, repairs, replacement or improvement of the Facility.

"**Security**" means any one or more of the following: the Bid Guarantee, the Performance Bond, or the Transfer Security.

"**Security Package**" consists of:

(a) this Agreement;

(b) the LLA;

(e) the Construction Contract;

(f) the O&M Contract (if applicable);

(g) the Financing Documents;

(i) the bylaws and articles of Project Company;

(j) the Equity Documents;

(k) the insurance policies required to be obtained by Project Company pursuant to Article 15;

(m) the documents creating or evidencing the security for the Lenders (including the Lenders' Direct Agreement);

(n) all Government Authorizations, including a generation license issued in accordance with [ ]; and

(o) any other Project Agreements to which Project Company is party.

"**Shares**" means shares of Project Company with voting or other rights of management and/or control.

"**Simple Cycle Unit**" means the unit of the Facility formed by the combustion turbines and the supplementary equipment for generation of electric power.

"**Site**" means the land on which the Facility is to be installed (defined by the boundaries [Insert site plot designation or coordinates]), and has been leased by GPA to Project Company by means of the LLA.].

"**Site Reference Conditions**" means the physical and meteorological conditions at which the Facility would be operating under hypothetical representative circumstances as defined in Schedule 1.

"**Start**" means the process of starting up a Unit or the Facility until its synchronization, when the corresponding Unit or Facility has been shut down.

"**Supplemental Charge**" means any additional charges agreed by the Parties which are payable by GPA to Project Company as part of the Price payments.

"**Technical Limits**" means the limits and constraints described in Schedule 2 relating to the operation and maintenance of the Facility, and which shall be in accordance with the Functional Specifications.

"**Term**" has the meaning set forth in Article 5.1.

"**Termination Notice**" has the meaning set forth in Article 5.5(b).

"**Testing**" means the process of testing the Facility pursuant to Article 8.

"**Threshold Capacity**" means a Dependable Capacity equal to ninety (90%) per cent of the Contracted Facility Capacity.

"**Transfer Date**" means the date upon which all ownership, custody and control of the Facility shall be transferred from Project Company to GPA, which date shall be the final day of the Term unless mutually agreed otherwise.

"**Transfer Security**" has the meaning set forth in Article 18.4.

"Typical Meteorological Year" or "TMY" – means, for a hybrid or renewable Facility, the set of meteorological conditions relevant to the performance of such Facility's Renewable Component or a renewable Facility, which was provided by the awarded Bidder including any subsequent changes made by GPA.

"ULSD" means means ultra-low sulfur diesel fuel with maximum sulfur content of 15 ppm suitable for firing by diesel engine generators or combustion turbine generators meeting Fuel quality specifications contained in Schedule 7.

"ULSD Bulk Storage" means GPA's existing GPA ULSD bulk storage located near the existing Cabras power station to be modified by the Project Company as required under this Agreement.

"**ULSD Storage Facilities**" has the meaning set forth in Article 4.3.1(g).

"ULSD Supply Infrastructure" means the ULSD Bulk Storage, and the ULSD supply pipeline between the ULSD Bulk Storage and the Site with all its associated systems, equipment, and accessories to be constructed by the Project Company and transferred to GPA on the Phase 1 Commercial Operation Date.

"**Unit**" means an individualgas turbine-gernerator, reciprocating engine-generator, or wind turbine-generator unit.

"**Unit Available Capacity**" means the capacity of each Unit (adjusted to Site Reference Conditions) announced by Project Company pursuant to Article 10.3(e).

"U.S. EPA" means the United States Environmental Protection Agency.

"**Variable Operation and Maintenance Charge**" has the meaning set forth in Schedule 5.

"**Wilful Misconduct**" means an intentional, conscious or reckless default in announcing an accurate Declared Capacity by a director, officer, manager or employee of Project Company exercising apparent authority to announce, or cause to be announced, a Declared Capacity, provided, however, that Wilful Misconduct shall not include any error of judgement or mistake made in good faith in the exercise of any function, authority or discretion arising under or in connection with the performance of this Agreement.

"**Year**" means a calendar year according to the Gregorian calendar beginning at midnight December 31 in Guam.

ARTICLE 2
INTERPRETATION

In this Agreement (including its Schedules), unless otherwise stated:

2.1 Any references to:

(a) any agreement (including this Agreement) or document shall be construed, at any particular time, as including a reference to the relevant agreement or document as it may have been amended, novated, assigned, modified or supplemented in accordance with its terms;

(b) the Preamble, Recitals or a particular Article or Schedule, shall be a reference to the Preamble, Recitals or relevant Article or Schedule in or to this Agreement;

(c) a particular paragraph or sub-paragraph, if contained in an Article or Schedule, shall be a reference to the relevant paragraph or sub-paragraph of that Article or Schedule; and

(d) a Party or any other person includes its successors in title, permitted assigns and permitted transferees.

2.2 Words in the singular may be interpreted as referring to the plural and vice versa.

2.3 A requirement that a payment be made on a Day which is not a Business Day shall be construed as a requirement that the payment be made on the next following Business Day.

2.4 The words "including" and “include” are to be construed as being at all times followed by the words "without limitation", unless the context otherwise requires.

2.5 For the purpose of any calculation under this Agreement, references to any period or periods of an hour or hours shall be rounded up to the nearest 1/10th of an hour.

2.6 The Schedules contained herein form an integral part of this Agreement. In the event of an inconsistency between the body of this Agreement and the Schedules thereto, the provisions of the body shall govern.

2.7 Where reference is made in this Agreement to a period or periods of time the periods in question shall be deemed to end at midnight on the last Day of such period unless otherwise stated.

2.8 Unless otherwise stated, whenever a consent or approval is required by one Party from the other Party, such consent or approval shall not be unreasonably withheld or delayed.

2.9 In carrying out its obligations and duties under this Agreement, each Party shall have an implied obligation of good faith.

2.10 Any capitalized term used but not defined in this Agreement shall have the meaning attributable thereto in the IFMSB.

2.11 The Parties agree that, should a situation arise where the provisions of Schedule 1 require clarification, then Form [ ] of the Proposal, to the extent relevant, would be used to interpret the provisions of Schedule 1, provided that this process in no event results in the modification of the Project Company's obligations hereunder or the imposition of obligations additional to those included in this Agreement.

2.12 Any reference to GPA's successors and permitted assigns shall be a reference to such successors and permitted assigns in all of GPA's capacities.

ARTICLE 3
RESERVED

ARTICLE 4
SALE AND PURCHASE OF CAPACITY AND ENERGY

4.1 Energy and Capacity

Subject to and in accordance with the terms and conditions of this Agreement, Project Company agrees to maintain and make available and deliver exclusively to GPA, and GPA agrees to accept and purchase from Project Company, from and after the Phase 1 Commercial Operation Date, for the consideration described in Article 14 and Schedule 5, the entire Dependable Capacity and, subject to Dispatch Instructions, the Net Energy Output of the Facility. GPA further agrees to pay to Project Company all amounts (and adjustments to amounts) described in Article 14.1 in the circumstances contemplated in Article 14.1. [Any Environmental Attributes associated with Dependable Capacity and Net Energy Output shall accrue to GPA's benefit.]

4.2 Sales to Third Parties and Test Energy

4.2.1 No Sales to Third Parties

The Parties agree that Project Company shall not during the Term sell or deliver electric capacity or energy produced by the Facility to any other entity than GPA.

4.2.2 No Payment for Test Energy

Prior to the Phase 1 Commercial Operation Date, GPA shall not pay for energy delivered to GPA during Testing and Commissioning.

4.3 Fuel Supply

4.3.1 Fuel Supply After COD

(a) Commencing as of the Phase 1 Commercial Operation Date, GPA shall deliver Fuel to Project Company in compliance with the Fuel Specifications for each day of operation, at such times as it may be required by Project Company to satisfy the hourly dispatch requirements to be provided by GPA (the "**Fuel Supply Requirement**"). All Fuel required to be delivered by GPA to Project Company under this Article shall be delivered to the corresponding Fuel Delivery Point and shall be measured at the corresponding Fuel Measurement Point in accordance with the provisions set forth in Schedule 12. Project Company shall be responsible for the installation, operation and maintenance of the Fuel measurement facilities.

(b) Unless Project Company informs GPA otherwise, the Fuel Supply Requirement shall be consistent with the Guaranteed Heat Rate specified in Schedule 2, adjusted to Site Conditions and expressed in BTUs per kWh. In the event the expected operating heat rate applicable to any period of operation is higher than the corresponding Guaranteed Heat Rate, Project Company shall inform the magnitude of the deviation, the likely cause of such deviation, and the way this deviation is going to be corrected. Project Company shall use its best efforts to meet the Guaranteed Heat Rate. GPA shall supply the Fuel Supply Requirement even if the expected operating heat rate is higher than the Guaranteed Heat Rate.

(c) Each Party shall cooperate reasonably with the other Party to coordinate the supply and transportation of Fuel to the Fuel Delivery Point with the operation of the Plant as follows: (x) by providing the other Party such information as the first Party shall reasonably request regarding the supply and transportation of the Fuel to the Fuel Delivery Point (on both a historical and estimated future basis); and (y) by maintaining personnel available at all times to address scheduling of Fuel supply and transportation.

(d) Subject to the foregoing, GPA shall have the right to change the quantities of Fuel nominated and received on a daily basis, or more frequently, to the extent permitted, so long as such changes do not disrupt Project Company's operations.

(e) GPA shall be deemed to be in exclusive control of, and responsible for any damage or personal injury caused by, Fuel up to the Fuel Delivery Point. Project

Company shall be deemed to be in exclusive control of, and responsible for any losses of Fuel, and any damages or injury caused by, such Fuel at and from the Fuel Delivery Point. GPA warrants that Fuel caused to be delivered hereunder to Project Company shall be free and clear of all liens or other encumbrances. Title to and risk of loss of all Fuel shall transfer from GPA to Project Company upon delivery to the Fuel Delivery Point.

(f) GPA undertakes that all Fuel delivered at the Fuel Delivery Point shall meet the Fuel Specifications. Project Company shall have the right to reject Fuel which fails to meet the Fuel Specification at the Fuel Delivery Point ("Non-Conforming Fuel") provided that Project Company has made commercially reasonable efforts to receive such Non-Conforming Fuel. If Project Company erroneously rejects Fuel that in fact meets the Fuel Specification, Project Company shall be liable to GPA for all damages caused by said rejection and shall indemnify and hold GPA harmless therefor. If either Party becomes aware that Fuel that is being or will be delivered by GPA to the Project Company fails to meet the Fuel Specification, such Party shall inform the other Party of this fact as soon as possible after becoming aware thereof.

(g) Project Company shall, in accordance with Schedule 1, construct and maintain storage facilities at the Site for the supply of ULSD for the operation of the Facility (the "ULSD Storage Facilities"). Such storage facilities shall be capable of holding an inventory equivalent to the amount of ULSD necessary to operate the Facility at the full Contracted Facility Capacity (in accordance with the Guaranteed Heat Rate) for at least fourteen (14) consecutive Days or such larger quantities as may be required by Lenders.

(h) Project Company shall, in accordance with Schedule 1 finance, design and construct the ULSD Supply Infrastructure and transfer it to GPA at no cost on the Phase 1 Commercial Operation Date. GPA will own, operate, and maintain the ULSD Supply Infrastructure during the Term of the ECA.

4.3.2 Fuel Supply During Testing and Commissioning

(a) GPA shall procure and deliver the Fuel required for start-up and commissioning prior to the Phase 1 Commercial Operation Date to the ULSD Bulk Storage pursuant to the specifications in Schedule 7. GPA shall pay for the Fuel required for start-up and commissioning up to a maximum of [ ]MMBtu and Project Company shall pay for any Fuel required and delivered in excess thereof. The Project Company shall be responsible for the operation and maintenance of the ULSD supply infrastructure prior to the Phase 1 Commercial Operation Date and the cost of first fill of ULSD in an amount equal to the Fuel storage requirements in Article 4.3.1(g) (the "First Fill"). At least eighteen (18) Months prior to the Expected Phase 1 Commercial Operation Date, Project Company and GPA shall agree to a procedure to periodically estimate and forecast the necessary amount of Fuel expected to be required for commissioning and start-up, provided, however, that the final amount of Fuel required shall be set no later than 120 days prior to the Expected Phase 1 Commercial Operation Date.

4.4 Natural Gas Supply

The following is applicable for Natural Gas if and when it becomes available and if and when GPA so elects to supply Natural Gas to the Facility.

4.4.1 Natural Gas Procurement

At any time after the Phase 1 Commercial Operation Date, GPA, in its sole discretion may elect to supply Natural Gas to the Facility and require that the Facility burn Natural Gas. The procedure set forth in Article 8.2(f) and (g) of this Agreement shall apply to the implementation of this election.

4.4.2 Natural Gas Nominations by the Project Company

After receiving the daily Dispatch Instructions, the Project Company shall provide to GPA the Natural Gas daily nominations as required by the Project Company to satisfy the Dispatch Instructions. The detailed procedure for daily nominations and for renominations shall be determined by the Joint Coordinating Committee.

4.5 Fuel Cost Allocation

When GPA receives bills for Fuel supply and transportation for the Facility, GPA shall send a copy to the Project Company. Once received by the Project Company, the Joint Coordinating Committee shall meet to distribute the cost between the Parties. The Project Company shall be responsible for the cost of any Fuel consumed in excess of the quantity of Fuel that should have been required to produce the applicable amount of Net Energy Output had the Facility operated in compliance with the Guaranteed Heat Rate as adjusted to the operating parameters provided in the applicable Dispatch Instructions. In the event that, in any given hour or portion thereof, the Facility is unavailable to operate at 100% load due to a reason other than the fault of GPA, and this event does not occur during a Scheduled Outage or Maintenance Outage or occurs during a Scheduled Outage or Maintenance Outage after the Facility has exceeded its Allowable Total Outages Energy for the applicable Contract Year pursuant to Article 9.3, then the Guaranteed Heat Rate used to calculate the Fuel cost allocation shall be the Guaranteed Heat Rate applicable to the load at which the Facility would have been dispatched had the Facility been available to operate at 100% load.

4.6 Set-off for Fuel Costs

Any amounts owed to GPA by the Project Company with respect to Fuel, if any, shall be deducted from the monthly invoice as set forth in Article 14.

4.7 Non-Conforming Fuel

(a) If Fuel supplied by GPA fails to conform to the specifications set out in Schedule 7 or Schedule 9 as the case may be ("Non-Conforming Fuel"), Project Company may send a Notice to GPA notifying that Project Company has received Non-Conforming Fuel.

(b) GPA shall, promptly upon becoming aware of such delivery or promptly upon receipt of the Notice from Project Company referred to in paragraph (a) above, send a Notice to Project Company stating, to the extent known to GPA, the period during which the Non-Conforming Fuel was delivered, the quantity thereof and how its specifications vary from the ones set out in Schedule 7 or Schedule 9, as the case may be.

(c) If, after exercising commercially reasonable efforts to receive the Non-Conforming Fuel, Project Company determines that it is unable to accept, or operate the

Facility, on such Non-Conforming Fuel, then it shall be under no obligation to accept such fuel. In the event that the Dependable Capacity would otherwise be available but for the delivery of Non-Conforming Fuel, then GPA shall remain obligated to pay the Capacity Charge.

ARTICLE 5
TERM, DEFAULTS AND REMEDIES

5.1 Term of Agreement

(a) Except for the provisions of Article 1, 2, 5, 6.6, 7, 11, 16, 17, 19, 20, 22, 23, and 23 (which shall commence and be effective upon the date of signature of this Agreement), the term of this Agreement ("**Term**") shall commence and be effective upon Financial Close (provided that this Agreement shall be effective upon satisfaction or waiver of all conditions precedent other than the condition to achieve Financial Close if the only condition precedent to Financial Close that is not satisfied or waived is that any or all of this Agreement or other Project Agreement is not in full force and effect because Financial Close has not occurred) and shall terminate twenty five (25) Contract Years after the Phase 1 Commercial Operation Date, unless extended or earlier terminated pursuant to the provisions of this Agreement. The termination of this Agreement shall be without prejudice to all rights and obligations of the Parties accrued under this Agreement prior to the date of such termination.

(b) On or before the end of the twenty-first (21st) Contract Year the Parties shall meet to discuss whether the Term of this Agreement shall be extended. To the extent the Parties agree to extend the Term, then the terms and conditions of this Agreement shall be negotiated and mutually agreed by the Parties, as required and appropriate. To the extent this Agreement is not extended, then this Agreement shall terminate in accordance with its terms and conditions, and the Parties shall commence the implementation of the Facility Transfer procedures set forth in Article 18.

5.2 Project Company Events of Default

The Project Company shall be in default under this Agreement upon the occurrence of any of the following events set forth in subsections (a) to (r) below (each a "**Project Company Event of Default**"); provided, however, that none of such events shall constitute a Project Company Event of Default if such event (a) results from a breach or default by GPA under this Agreement or the LLA or (b) occurs as a result of, or during, a Force Majeure pursuant to Article 17.

Subject to the provison in the preceding sentence, the following are Project Company Events of Default:

(a) the failure of Project Company to achieve Financial Close by the Required Financial Closing Date [due to the failure of the Project Company, in the reasonable opinion of GPA, to use commercially reasonable efforts to do so];

(b) the failure of Project Company to issue Notice to Proceed to the Construction Contractor within two (2) Business Days after Financial Close;

(c) prior to the achievement of the Phase 1 Commercial Operation Date, an Abandonment occurs without GPA's prior written consent and continues for a period of thirty (30) consecutive Days from the receipt of a Notice from GPA;

(d) the failure of Project Company to achieve the Phase 1 Commercial Operation Date within a period of one hundred and twenty (120 Days) after the Required Phase 1 Commercial Operation Date;

(e) the failure of the Project Company to achieve the Phase 2 Commercial Operation Date within one hundred and twenty (120) Days after the Required Phase 2 Commercial Operation Date;

(f) the failure of Project Company to submit the Performance Bond on or before Financial Close;

(g) the failure of the Project Company to establish and maintain any Security in accordance with the terms of this Agreement; after the Phase 1 Commercial Operation Date, an Abandonment occurs without the prior written consent of GPA and continues for a period of fifteen (15) consecutive Days from receipt of a Notice from GPA;

(h) the failure of the Facility to achieve the Threshold Capacity upon completion of the Phase 2 Commercial Operation Tests under Article 8.1 or, after the Phase 2 Commercial Operation Date, the failure of the Facility to (A) achieve a Dependable Capacity level equal to eighty-five (85%) per cent of the Initial Dependable Capacity after any Dependable Capacity Test and (B) achieve such level of Dependable Capacity after a later Dependable Capacity Test or otherwise make available to GPA such level of capacity, in each case no later than six (6) Months after the test mentioned in (A) above, provided that, in the case of a failure of equipment where the Project Company can demonstrate that replacement equipment has been ordered, or that a repair has been undertaken, as soon as reasonably practicable after the failure (taking into account the amount of time required to determine whether a repair can be achieved), but in any event no later than the end of such 6 Month period, such period shall be extended for as long as Project Company is awaiting delivery of such equipment or is otherwise diligently pursuing a cure of the cause of the failure, up to a maximum of fifteen (15) Months;

(i) should the Facility experience more than 285 Outage Hours in each month for a period of six (6) consecutive Months, provided that, in the case of a failure of equipment where the Project Company can demonstrate that replacement equipment has been ordered, or that a repair has been undertaken, as soon as reasonably practicable after the failure (taking into account the amount of time required to determine whether a repair can be achieved), but in any event no later than the end of such six (6) Month period, such period shall be extended for as long as the Project Company is awaiting delivery of such equipment or is otherwise diligently pursuing a cure of the Forced Outage, up to a maximum of fifteen (15) Months;

(j) Project Company's failure to operate, maintain, modify, or repair the Facility in accordance with Prudent Utility Practices and applicable environmental Laws, such that safety of persons and property (including the Facility) is materially adversely affected, and such failure shall continue unremedied for a period of

thirty (30) Days after Notice from GPA, provided that where Project Company has implemented a remedial plan approved by GPA, such failure shall continue unremedied for a period of ninety (90) Days after Notice from GPA;

(k) the occurrence of any of the following events: (i) the passing of a resolution by the Investors for voluntary liquidation (or other similar relief) of Project Company; (ii) the appointment of a liquidator by Project Company or by the Controller of Companies for liquidation of Project Company; (iii) submission of an application to a court of competent jurisdiction for mandatory liquidation of Project Company which application is not dismissed within ninety (90) Days, (iv) the issuance of a final and conclusive order by a court of competent jurisdiction for liquidation or winding up of Project Company; or (v) except as otherwise permitted under and pursuant to the Financing Documents or the Project Agreements, the transfer, conveyance, loss, or relinquishment to any person of Project Company's right to own and/or operate the Facility or any material part thereof or to occupy the Site without the prior written approval of GPA;

(l) any statement, representation or warranty by Project Company in this Agreement proves to have been incorrect, in any material respect, when made and such failure or incorrect statement, representation, or warranty has a material and adverse effect on Project Company's ability to perform its obligations under this Agreement;

(m) the failure of Project Company to make any payment or payments required to be made by it hereunder (other than payments disputed by Project Company in good faith and by Notice to GPA) within fifteen (15) Days of the due date for such payment;

(n) any material breach by Project Company of this Agreement (other than any such breach referred to elsewhere in this Article 5.2), that is not remedied within sixty (60) Days after Notice from GPA to Project Company (which Notice shall (i) state that a material breach of this Agreement has occurred that could result in the termination of the Agreement; (ii) identify the material breach in question in reasonable detail; and (iii) demand remedy thereof);

(o) the occurrence of a Project Company Event of Default under any project agreement (as such term is defined in each of such agreements respectively), which is not cured within the applicable cure period (if any) provided for therein;

(p) Project Company makes an assignment of this Agreement or transfers or creates a lien on the Project in violation of Article 21.2;

(q) The failure of Project Company to obtain or maintain the Governmental Authorizations which is not remedied within ninety (90) Days after Notice from GPA;

(r) Except as otherwise provided in this Article 5.2, Project Company shall fail to comply with any of its other obligations under this Agreement and such failure has a material adverse effect upon GPA, and such failure shall continue uncured for sixty (60) Days after notice thereof by Company, provided that if such failure is not capable of being cured within such period of sixty (60) Days with the exercise of commercially reasonable efforts, then such cure period shall be extended for an additional reasonable period of time (not to exceed one-

hundred-twenty (120) Days) so long as Project Company is exercising commercially reasonable efforts to cure such failure;

GPA shall deliver to the Lenders' agent ("**Agent**") (in accordance with the Lenders' Direct Agreement) a copy of any Notice given under this Article 5.2.

5.3 GPA Events of Default

GPA shall be in default under this Agreement upon the occurrence of any of the following events set forth in subsections (a) to (e) (each a "**GPA Event of Default**"); provided, however, that none of such events will constitute a GPA Event of Default if such event (i) results from a breach or default by Project Company under this Agreement or the LLA, or (ii) occurs as a result of a Force Majeure pursuant to Article 17. Subject to the proviso in the preceding sentence, the following are GPA Events of Default:

(a) the submission for voluntary liquidation (or other similar relief) of GPA by GPA or any Government Entity with the authorization to make such submission, the appointment of a liquidator by GPA [or the Public Utilities Commission], the submission of an application to a court of competent jurisdiction for mandatory liquidation of GPA which application is not dismissed within ninety (90) Days, or the issuance of a final and conclusive order by a court of competent jurisdiction for liquidation or winding up of GPA;

(b) any default or defaults by GPA in the making of any payment or payments (other than payments disputed by GPA in good faith and by Notice to Project Company) required to be made by it within thirty (30) Days of the due date for such payment;

(c) any material breach by GPA of this Agreement (other than any such breach referred to elsewhere in this Article 5.3) that is not remedied within sixty (60) Days after Notice from the Project Company to GPA (which Notice shall (i) state that a material breach of this Agreement has occurred that could result in the termination of this Agreement, (ii) identify the material breach in reasonable detail and (iii) demand remedy thereof);

(d) any statement, representation, or warranty made by GPA in this Agreement proves to have been incorrect in any material respect when made, and such failure or incorrect statement, representation, or warranty has a material and adverse effect on GPA's ability to perform its obligations under this Agreement; or

(e) the occurrence of a GPA Event of Default under the LLA (as such term is defined therein) which is not cured within the applicable cure period (if any) provided for therein.

The Project Company shall deliver to the Agent a copy of any Notice given under this Article 5.3.

5.4 GPA Early Termination and Termination for Prolonged Force Majeure

(a) GPA shall have the right to terminate this Agreement for convenience at any time subject to the terms and procedures set forth in Article 5.5(e).

(b) GPA shall have the right to terminate this Agreement during a Prolonged Force Majeure, subject to the terms and procedures set forth in Article 5.5(g), unless the Project Company is exercising its [best efforts] to resolve the impact of the underlying Force Majeure event on the Project's performance and that such resolution is reasonably expected to occur within three (3) months and result in the Facility operating, on a continuing basis, with an annual availability of 90% or more.

5.5 Termination Notices and Rights

(a) Upon the occurrence of a GPA Event of Default or a Project Company Event of Default, as the case may be, the non-defaulting Party may, subject to the Lenders' Direct Agreement at its option, initiate termination of this Agreement by delivering a Notice (a "**Notice of Intent to Terminate**") of its intent to terminate this Agreement to the defaulting Party and the Agent. The Notice of Intent to Terminate shall specify in reasonable detail the Project Company Event of Default or the GPA Event of Default, as the case may be, giving rise to such Notice.

(b) Following the delivery of a Notice of Intent to Terminate, the Parties shall consult for a period of up to forty-five (45) Days in the case of a failure by either Party to make payments when due, and up to sixty (60) Days with respect to any other Event of Default (or such longer period as the Parties may mutually agree), as to what steps shall be taken with a view to mitigating the consequences of the relevant Event of Default taking into account all the circumstances. During the period following the delivery of the Notice of Intent to Terminate, the Party in default may continue to undertake efforts to cure the Event of Default, and if the Event of Default is cured at any time prior to the delivery of a Termination Notice in accordance with Article 5.5(b) then the non-defaulting Party shall have no right to terminate this Agreement in respect of such cured Event of Default.

(c) Upon expiration of the consultation period described in Article 5.5(a) and unless the Parties shall have otherwise agreed or unless the Event of Default giving rise to the Notice of Intent to Terminate shall have been remedied, the Party having given the Notice of Intent to Terminate may, subject to the Lenders' Direct Agreement and the conditions set forth in sub-sections (d)-(h) below, terminate this Agreement by delivery of a Notice (a "**Termination Notice**") to the other Party and the Agent, whereupon, subject to the Lenders' Direct Agreement, this Agreement shall immediately terminate.

(d) In the event of a termination by Project Company due to a GPA Event of Default, GPA shall have the right, but not the obligation, to acquire the Facility from Project Company for the applicable GPA Default Transfer Price set forth in Schedule 10. In order to exercise such right, GPA shall provide Project Company with Notice of its election to acquire the Facility within sixty (60) Days of receiving the applicable Notice of Intent to Terminate from Project Company, after which the Parties will commence working together diligently and in good faith to effect such transfer within forty-five (45) Days or as soon as practicable thereafter.

(e) In the event of an early termination by GPA for convenience pursuant to Article 5.4, GPA shall be required to acquire the Facility from Project Company for the applicable Early Transfer Price set forth in Schedule 10. The Parties shall work

together diligently and in good faith to effect such transfer within forty-five (45) Days of Project Company's receipt of GPA's early termination Notice or as soon as practicable thereafter.

(f) In the event of a termination by GPA due to a Project Company Event of Default, GPA shall have the right, but not the obligation, to acquire the Facility from Project Company for the applicable Project Company Default Transfer Price set forth in Schedule 10. In order to exercise such right, GPA shall provide Project Company with Notice of its election to acquire the Facility within sixty (60) Days of the date Project Company received the Notice of Intent to Terminate from GPA, after which the Parties shall commence working together diligently and in good faith to effect such transfer within forty-five (45) Days or as soon as practicable thereafter.

(g) In the event of a termination by GPA due to a Prolonged Force Majeure pursuant to Article 5.4, GPA shall have the right, but not the obligation, to acquire the Facility from Project Company for the applicable FM Transfer Price set forth in Schedule 10. In order to exercise such right, GPA shall provide Project Company with Notice of its election to acquire the Facility within sixty (60) Days of the date Project Company receives the applicable Notice of Intent to Terminate from GPA, after which the Parties will commence working together diligently and in good faith to effect such transfer within ninety 90 days or as soon as practicable thereafter.

(h) Any transfer contemplated in sub-sections (d)-(g) above shall be free and clear of all liens or other encumbrances and shall include all right, title and interest in and to the Facility including all fixtures, fittings, plant and equipment (including all test equipment, special tools, as-built drawings, software, documents, reports, analyses, all relevant files, plant procedures and forms as reasonably required and necessary for GPA to effectively operate the Facility after the transfer) and all improvements comprising the Facility.

(i) In the event of a termination resulting in Project Company (or any successor thereof) continuing to be the owner of the Facility, the Parties shall enter into a connection agreement (the "Connection Agreement") whereby the Project Company shall be granted the exclusive rights to use the Electrical Interconnection Facilities and to provide Facility capacity and inject Facility energy to the Grid System at the Delivery Point as if this Agreement had not been terminated; provided that the Connection Agreement shall (i) be compliant with the applicable system grid code, (ii) have a term that is equal to or greater than the remaining term of this Agreement immediately prior to its termination, and (iii) obligate GPA to operate and maintain the Electrical Interconnection Facilities in accordance with the applicable system grid code and Prudent Utility Practices for a reasonable and customary annual fee limited to the amount necessary to cover the reasonable costs of such operation and maintenance.

5.6 Other Remedies

(a) The exercise of the right of a Party to terminate this Agreement, as provided herein, does not preclude such Party from exercising other remedies that are provided herein or available at law, provided that, notwithstanding the above:

i. no Party may terminate this Agreement other than in accordance with the express terms of this Agreement;

ii. the termination rights, rights to liquidated damages, and right to draw under the Performance Bond as expressly set out in this Agreement shall be the sole and exclusive remedies available to GPA against Project Company or the Project for any delay in Commissioning or failure of the Facility to be available or to meet the Dependable Capacity and/or outage requirements set out in this Agreement; and

iii. The termination right and right to draw under the Bid Guarantee shall be the sole and exlcusive remedies available to GPA against Project Company for failure to achieve Financial Close by the Required Financial Closing Date.

(b) Subject to Article 5 and paragraph (a) above, remedies are cumulative, and the exercise of, or failure to exercise, one or more of them by a Party shall not limit or preclude the exercise of, or constitute a waiver of, other remedies by such Party.

ARTICLE 6
COVENANTS, REPRESENTATIONS AND WARRANTIES

6.1 Project Company Covenants

The Project Company hereby covenants and agrees with GPA to:

(a) Develop, design, permit, engineer, finance, construct and complete the Facility in a good and workmanlike manner, only with materials and equipment that are new and of international utility-grade quality, and in all material respects in accordance with:

i. the Functional Specifications set forth in Schedule 1;

ii. the plans and specifications prepared in accordance with this Agreement;

iii. the Technical Limits set forth in Schedule 2;

iv. the EPA requirements;

v. all applicable Laws and the Government Authorizations;

vi. Prudent Utility Practices; and

vii. FERC and NERC requirements.

(b) Design, engineer, construct and complete the Facility in such a manner as to provide, with proper maintenance and operation, that the useful life of the Facility will be at least equal to 30 years;

(c) After the Phase 1 Commercial Operation Date, operate and maintain the Facility in all material respects, in accordance with:

i. the operating procedures developed pursuant to Article 7.4 and the Dispatch Instructions;

ii. the Technical Limits set forth in Schedule 2;

iii. the Guam and U.S. EPA requirements;

iv. all applicable Laws and the Government Authorizations; and

v. Prudent Utility Practices.

(d) Use all reasonable efforts to procure and maintain all Government Authorizations necessary for its performance under this Agreement;

(e) Engage only such advisors, representatives and experts as are experienced in the development, engineering, construction, financing, operation and maintenance of power stations similar to the Facility;

(f) Provide at its own risk and expense the necessary facilities and services for the safety, comfort and protection of its personnel;

(g) Work and cooperate in good faith with GPA with respect to all of GPA's obligations and rights hereunder.

6.2 GPA Covenants

GPA hereby covenants and agrees with Project Company to:

(a) Work with and cooperate in good faith with Project Company with respect to all of Project Company's obligations and rights hereunder;

(b) [Upon request by Project Company, GPA shall use its reasonable efforts to support Project Company in obtaining the Government Authorizations required by the provisions of Article 7.]

6.3 The Project Company Representations and Warranties

The Project Company hereby represents and warrants at the date of this Agreement that:

(a) The Project Company is a company duly organised, validly existing and in good standing under the Laws of Guam, and Project Company has all requisite corporate power and authority to conduct its business, to own its properties, and to execute, deliver, and perform its obligations under this Agreement;

(b) The execution, delivery and performance by Project Company of this Agreement have been duly authorised by all necessary corporate action on the part of Project Company, and do not and will not:

i. require any consent or approval of Project Company's Board of Directors, shareholders or partners other than those which have been obtained (evidence of which consents and approvals shall be, if it has not heretofore been, delivered to GPA upon its request), or

ii. violate or result in a breach of, or constitute a default under any provisions of Project Company's articles and memorandum of association or bylaws or other organic documents, or any material indenture, contract, or agreement to which it is a party or by which it or its properties may be bound, or any material law, rule, regulation, order, writ, judgment, injunction, decree, determination, or award presently in effect applicable to Project Company.

(c) To the best of Project Company's knowledge, no Government Authorization or approval by any other Government Authority is necessary for the due execution, delivery and performance by Project Company of this Agreement;

(d) This Agreement is a legal, valid and binding obligation of Project Company, enforceable against Project Company in accordance with its terms; and

(e) There is no pending or, to the best of Project Company's knowledge, threatened action or proceeding against Project Company before any court, Government Authority or arbitrator that could materially and adversely affect the financial condition or operation of Project Company or the ability of Project Company to perform its obligations hereunder, or that could affect the legality, validity or enforceability of this Agreement (as in effect on the date hereof).

6.4 GPA Representations and Warranties

GPA hereby represents and warrants at the date of this Agreement that:

(a) GPA is a public corporation and an enterprise fund of the Government of Guam established by the Guam Power Authority Act of 1968, duly organised, validly existing, and in good standing under the Laws of Guam, and has all requisite corporate power and authority to conduct its business, to own its properties, and to execute, deliver, and perform its obligations under this Agreement.

(b) The execution, delivery and performance by GPA of this Agreement have been duly authorised by all necessary corporate or Government action, and do not and will not:

i. require any consent or approval of GPA's Board of Directors, shareholders, officers, or officials other than those which have been obtained (evidence of which consents and approvals shall be, if it has not heretofore been, delivered to the Project Company upon its request);

ii. violate or result in a breach or constitute a default under any provisions of GPA's articles and memorandum of association or bylaws, or other organic documents, or any material indenture, contract, or agreement to which it is a party or by which it or its properties may be bound, or any material law, rule, regulation, order, writ, judgment, injunction, decree, determination, or award presently in effect applicable to GPA.

(c) To the best of GPA's knowledge, no Government Authorization or approval by any other Government Authority is necessary for the due execution, delivery and performance by GPA of this Agreement other than [ ].

(d) This Agreement is a legal, valid, and binding obligation of GPA, enforceable against GPA in accordance with its terms.

(e) There is no pending or, to the best of GPA's knowledge, [threatened action or proceeding against GPA before any court], Government Authority, or arbitrator that could materially and adversely affect the financial condition or operation of GPA or the ability of GPA to perform its obligations hereunder, or that could affect the legality, validity or enforceability of this Agreement (as in effect on the date hereof).

6.5 Not used.

6.6 Pre-Existing Site Condition

(a) If a Pre-Existing Site Condition is discovered during the Pre-Existing Site Condition Period, Project Company will notify GPA within fourteen (14) Days of such discovery (or, if later, the date when Project Company becomes aware of such discovery).

(b) Following a notification under paragraph (a) above, Project Company will promptly submit to GPA a remediation plan and a proposal for the cost of any remedial action required to remove such Pre-Existing Site Condition. Within thirty (30) Days of receipt of such plan and proposal, GPA will either (i) approve the remediation plan and proposal or (ii) not approve the remediation plan and proposal (setting out in reasonable detail the reasons therefore).

(c) In the event that GPA does not approve the remediation plan and proposal proposed by Project Company, GPA and Project Company shall discuss in good faith to attempt to agree to such a plan and proposal for a period of thirty (30) Days. In the event of a failure to agree to such a plan and proposal within such thirty (30) Days, GPA shall carry out, or shall appoint a third party to carry out, the remediation work and Project Company shall grant access to the Site to GPA or such third party for this purpose, provided that the remediation work shall be carried out on a timely basis and in a manner that does not interfere with the activities of Project Company and its Contractors, and that all persons present on the Site on behalf of GPA (or the third party appointed by it to carry out the remediation work) will comply with Project Company or its Contractors' safety rules.

(d) GPA may not unreasonably withhold or delay its consent in relation to any remediation plan and proposal delivered by Project Company pursuant to this Article 6.6 and failure by GPA to respond to any remediation plan and proposal within fifteen (15) Days of receipt of such proposal shall be deemed to constitute GPA's consent to such remediation plan and proposal.

(e) Following any remediation plan and proposal being agreed (or being deemed to have been agreed) by Project Company and GPA and subject to subsections 6.6(g) and (h) below:

i. Project Company shall be responsible for the first one million Dollars (US$1,000,000) (in aggregate) of remediation costs resulting from the discovery of Pre-Existing Site Condition(s) during the Pre-Existing Site Condition Period; and

ii. GPA shall be responsible for all remediation costs resulting from the discovery of Pre-Existing Site Condition(s) during the Pre-Existing Site Condition Period in excess of the one million Dollars (US$1,000,000) of costs (in aggregate) to be met by Project Company, and GPA shall pay such costs to Project Company within thirty (30) Days of receipt of an invoice from Project Company in respect of such costs. Notwithstanding the above, only reasonable and documented remediation costs shall be considered in determining whether and to what extent GPA may be responsible for remediations costs under this subsection 6.6(e).

(f) Late payment of any invoice delivered by Project Company under this Clause shall accrue interest in accordance with Clause 14.4 (Late Payment). Project Company shall not be in default or breach of any of its obligations under this Agreement where directly attributable to a Pre-Existing Site Condition.

(g) Project Company shall exercise its best efforts to mitigate the effects and costs of any Pre-Existing Site Condition. GPA shall have no obligation to pay any remediation costs pursuant to this Article 6.6 to the extent such costs are incurred due to a failure by Project Company to meet its obligation under this subsection (g).

(h) Prior to finalizing the Facility design, Project Company shall perform early-stage site investigation and analysis consistent with Prudent Utility Practices. GPA shall not be obligated to pay remediation costs (and subsection (f) shall not excuse Project Company from any of its obligations under this Agreement) for any Pre-Existing Site Condition that was not notified to GPA within fourteen (14) Days of the earlier of the date such condition was discovered and the date upon which such condition should have been discovered had Project Company complied with its obligation under this subsection (h).

(i)

ARTICLE 7
PRE-OPERATIONAL PERIOD

7.1 Permits, Licenses and Approvals

Prior to the Phase 2 Commercial Operation Date, Project Company shall, at its own expense, obtain and maintain all Government Authorizations or any other permit, license, approval or authorization required to be obtained and maintained by Project Company as and when required to comply with its obligations under this Agreement, including reaching Financial Close by the Required Financial Closing Date, achieving the Phase 1 Commercial Operation Date by the Required Phase 1 Commercial Operation Date, and achieving the Phase 2 Commercial Operation Date by the Required Phase 2 Commercial Operation Date.

7.2 Documents to be Submitted by Project Company

Project Company shall provide the following documents to GPA:

(a) As soon as available but no later than the earlier of Financial Close and Notice to Proceed, a complete copy of the Construction Contract, including all exhibits and schedules thereto, and complete plans and specifications for the

construction of the Facility, including drawings and interconnection points for SCADA and AGC, as soon as practical as these are completed, provided that the Project Company shall be entitled to request approval from GPA to redact certain commercial terms from the copy of the Construction Contract.

(b) As soon as available but no later than the earlier of Financial Close and Notice to Proceed, a complete copy of the O&M Contract (if applicable), including all exhibits and schedules thereto, provided that Project Company shall be entitled to request approval from GPA to redact certain commercial terms from the copy of the O&M Contract supplied to the GPA.

(c) As soon as available but no later than Financial Close, a complete copy of [placeholder for any other relevant agreements].

(d) On or before Financial Close, complete copies of all Government Authorizations that have been issued to Project Company for the design, financing, construction, operation and maintenance of the Facility.

(e) As soon as available, copies of all Government Authorizations other than those provided under the preceding clause that have been issued to Project Company or the Contractors (as applicable) for the design, financing, construction, operation and maintenance of the Facility.

(f) On or before Financial Close, a copy of Project Company's quality control program, [safety program, environmental compliance program, and security (including cybersecurity) program, each] with respect to all aspects of the design, engineering, equipping, construction, and operation and maintenance of the Facility.

(g) On or before the Construction Start Date, complete copies of all insurance policies and certificates of insurance required for construction as indicated in Article 15, provided that Project Company shall be entitled to redact from the copy of the insurance policies supplied to GPA, all commercial terms and all other information that Project Company reasonably considers to be of a confidential or proprietary nature.

(h) As soon as available, but not later than the Phase 1 Commercial Operation Date, complete copies of all insurance policies and certificates of insurance obtained pursuant to Article 15 other than those provided under the preceding clause.

(i) At least one hundred and twenty (120) Days (or such other period as shall be agreed between the Parties) before the scheduled commencement of the Testing and Commissioning for Phase 1, detailed programs and protocols to be used during the Testing and Commissioning of the Facility consistent with the provisions of this Agreement, including Article 8 and Schedule 4. The GPA Engineer and GPA shall have the opportunity to comment on the proposed program and protocols within thirty (30) Days of receipt from Project Company of said documentation, and the GPA Engineer, GPA, and Project Company will work together to agree on the procedures and protocols to be used for Testing and Commissioning not later than sixty (60) Days prior to the scheduled commencement of the respective Testing and Commissioning.

(j) At least sixty (60) Days before the scheduled commencement of the Phase 1 Commercial Operation Tests, the intended start up and test schedule.

(k) Not later than thirty (30) Days after the Commercial Operation Date for each Phase, copies of all test results, certified by the GPA Engineer, for the Commercial Operation Tests performed with respect to such Phase.

(l) All the drawings, manuals, procedures, and other technical documents listed in Schedule 1 at the time specified in Schedule 1.

7.3 Supply of Power

(a) The Project Company will arrange for the supply of all electrical energy and capacity required for construction of the Facility through (i) self-generation, or (ii) to the extent available, through making arrangements to purchase construction power from the GPA.

(b) GPA will arrange for backfeed power to be available at the Harmon Substation as required for testing and commissioning in accordance with the parameters set forth in Schedule 8. Any such backfeed power shall be charged to Project Company at the prevailing rates applicable to such power.

(c) Project Company will arrange for the supply of all electrical energy and capacity required for the maintenance and operation of the Facility by (i) generating it with Project Company's own facilities, or (ii) to the extent available, using backfeed power through GPA's Harmon substation. Any such backfeed power, to the extent it is supplied by GPA, shall be paid to GPA by Project Company at the then current rate for electricity at that location.

7.4 Operating Procedures

(a) Not later than one hundred eighty (180) Days before the Required Phase 1 Commercial Operation Date, Project Company shall provide GPA with a first draft of its proposed operating procedures dealing with all operation interfaces between GPA and Project Company, including the method of day-to-day communication, key personnel lists, clearances and switching practices, outage scheduling, capacity and energy reporting, operating log and reactive power support, which procedures shall be consistent with this Agreement, the designs of the Facility and the Grid System (including the principles and guidelines developed by GPA for the Grid System as part of and in accordance with the applicable system grid code and as provided to Project Company), and Prudent Utility Practices (the "Operating Procedures"). GPA shall cooperate with Project Company, including by providing responses to reasonable requests for information submitted by Project Company in preparation of the Operating Procedures.

(b) Within ninety (90) Days after GPA's receipt of the first draft of the Operating Procedures, GPA shall notify Project Company of any requested deletions, amendments or additions which, in the exercise of GPA's reasonable judgment, are necessary or desirable. Project Company shall make any deletions, amendments or additions that GPA reasonably requests unless such requests would be inconsistent with this Agreement, the designs of the Facility, and the Grid System or Prudent Utility Practices. GPA may, from time to time, require the

Operating Procedures to be revised to conform to any duly established grid code binding on GPA to the extent that those revisions are not inconsistent with the terms of this Agreement, the designs of the Facility, the Grid System (including the principles and guidelines developed by GPA as part of and in accordance with the applicable system grid code for the Grid System), and Prudent Utility Practices.

7.5 GPA Observation Visits

GPA shall have the right, upon reasonable prior Notice, and subject to the safety rules and regulations of Project Company, to have its agents or employees at the Site at any time; provided that (i) such visits do not unreasonably interfere with the construction, testing, Commissioning, operation or maintenance of the Facility and (ii) such visits are at GPA's own expense. All persons visiting the Facility on behalf of GPA shall comply with the reasonable instructions and directions of Project Company and/or its Contractors. GPA shall bear responsibility for any claim, demand, action, proceeding, loss or damage to such persons or any property of Project Company caused by the negligence or wilful misconduct of any persons visiting pursuant to this Article 7.5 or the negligence or wilful misconduct of GPA during such visits. Insurance policies issued to Project Company must also cover GPA personnel and the GPA Engineer during their visits to the Site during the Term.

7.6 Project Company Progress Reports

Commencing on the date of this Agreement and continuing until the end of the Term, the Project Company shall submit progress reports to GPA prior to the fifteenth (15th) Day of each Month. Such reports shall cover in reasonable detail the progress in the development, permitting, financing, procurement, construction, and operation of the Facility for the preceding Month.

Prior to the Phase 2 Commercial Operation Date, the progress report shall include, as a minimum, an updated critical path schedule, a list of activities completed in the preceding month, a list of activities behind schedule and reasons therefor, a recovery plan for activities more than 30 days behind schedule, a safety report specifying all safety related incidents (e.g. fatalities, lost time accidents, and near misses), and a list and description of outstanding issues or concerns impacting, or reasonably expected to impact, the Project or its implementation schedule.

Subsequent to the Phase 1 Commercial Operation Date, the progress report shall include, as a minimum, an operational performance report (including hours of operation, gross and net capacity, heat rate, auxiliary load, number of trips, outages, or derations), description of maintenance activity, an updated maintenance plan, a safety report specifying all safety related incidents (e.g. fatalities, lost time accidents, and near misses), a list and detailed description of any environmental or security violations and a list and description of outstanding issues or concerns impacting the operation and maintenance of the Facility.

ARTICLE 8
TESTING OF THE FACILITY

8.1 Testing of the Facility Prior to the Commercial Operation Date

(a) Project Company shall provide to GPA on an on-going basis relevant information regarding its program for testing the Facility, including any delay suffered, or reasonably anticipated to be suffered, in the date of synchronization of a Unit (or Facility) or to the Expected Phase 1 or Phase 2 Commercial Operation Dates.

(b) Not less than sixty (60) Days prior to each of the Expected Phase 1 Commercial Operation Date and Phase 2 Commercial Operation Date, Project Company will deliver to GPA in writing the final program for testing, including the expected duration of Project Company's start-up and testing program and a tentative schedule for conducting all tests required by Schedule 4. Project Company shall advise GPA in writing of its final schedule for the testing program not less than fifteen (15) Days prior to the commencement of the tests required by Schedule 4. If the schedule for any test required by Schedule 4 is adjusted after Project Company has provided GPA with the final testing program schedule, Project Company shall advise GPA not less than seventy-two (72) hours prior to the commencement of any such test. On each Day beginning with the Day on which testing commences, Project Company shall provide GPA with a schedule of the tests to be conducted on the following Day or Days, if such test will continue for more than one (1) Day. All testing of the Facility shall satisfy the requirements provided in Schedule 4 and the procedures and protocols agreed upon by GPA, Project Company, and the GPA Engineer pursuant to Article 7.2(i). GPA will make all reasonable efforts to accept all the energy generated by the Facility during the Period of Testing and enable full load operation of the Facility during Dependable Capacity Tests.

(c) If GPA is unable to accommodate the schedule for such test or tests as provided by Project Company in the final schedule for the program of tests pursuant to the foregoing Article 8.1(b), GPA will give Project Company a Notice regarding deferral of any test or tests within seventy-two (72) hours of its receipt of the final schedule for testing, and the Parties will mutually agree on a date for any deferred test or program of tests.

(d) Additional Commercial Operation Tests

i. Project Company shall be entitled to attempt as many Commercial Operation Tests as are necessary to ensure that each Phase is Commissioned in accordance with the requirements of this Agreement. Project Company shall give GPA not less than seventy-two (72) Hours' Notice of each additional Commercial Operation Test it desires to attempt.

ii. Notwithstanding Article i, if the results of a Commercial Operation Test satisfy the applicable minimum performance criteria for successful completion of such Commercial Operation Test, but Project Company is not satisfied with the results of such Commercial Operation Test, Project Company may request additional tests to establish the results of the Commercial Operation Test with at least seventy-two (72) Hours' prior Notice provided to GPA prior to a subsequent test; provided, however, that Project Company will continue to be responsible for any delay liquidated damages under Article 9.1 and will not be paid for capacity until it has

notified GPA that Project Company has designated the test as the Commercial Operation Test in accordance with sub-clause (iii) below.

iii. When Project Company is satisfied with a test to establish the Phase 1 Commercial Operation Date or Phase 2 Commercial Operation date, as the case may be, Project Company shall notify GPA that Project Company has designated such test as the Commercial Operation Test. The Initial Dependable Capacity shall be set at any level successfully demonstrated during the Commercial Operation Test up to the Contracted Facility Capacity.

iv. The Phase 1 Commercial Operation Date and the Phase 2 Commercial Operation Date shall occur and payment for Capacity Charges shall commence as of the first Day after the Day the relevant Phase is Commissioned. In the event that Project Company is unable to demonstrate in the Phase 2 Commercial Operation Tests (carried out in accordance with the foregoing subparagraph (d)(i)) that the Facility is capable of operating at Threshold Capacity, GPA may terminate this Agreement as a Project Company Event of Default in accordance with Article 5.5.

8.2 Testing of Dependable Capacity and Heat Rate of the Facility after the Commercial Operation Date

The following provisions with respect to Testing the Facility after the Phase 2 Commercial Operation Date shall apply:

(a) Dependable Capacity shall be tested annually (at Project Company's cost) after the Phase 2 Commercial Operation Date at times mutually agreed upon by Project Company and GPA. Project Company may, within twenty-four (24) hours of completion of a Dependable Capacity Test, reject the test and may conduct a retest (at Project Company's cost) at a time to be mutually agreed; provided, however, that Project Company cannot conduct more than two (2) retests of any Dependable Capacity Test before the level of capacity achieved during such a test is set as the Dependable Capacity. Project Company shall give GPA at least forty eight (48) hours' prior Notice of the first retest and twenty four (24) hours' prior Notice of the second retest, and any retest shall be conducted within ten (10) Days after the completion of the rejected test.

(b) The test period for the Dependable Capacity Test shall be for six (6) continuous hours for a fossil fuel fired Facility or a Fossil Fuel Fired Component of the hybrid Facility. The test shall be run using the Metering System and plant instrumentation for measurements, unless otherwise decided by the Joint Coordinating Committee. The Dependable Capacity shall be the Net Energy Output (excluding any Excess Energy) during those six (6) hours corrected for Site Reference Conditions divided by six (6), but may not exceed the Contracted Facility Capacity. If, as the result of a Dependable Capacity Test, the tested capacity is shown to be above the Dependable Capacity in effect prior to such test, Project Company shall set the Dependable Capacity at the new tested capacity up to the Contracted Facility Capacity, and payments for the Dependable Capacity shall be increased accordingly, effective the Day such Dependable Capacity Test is completed. If, as a result of the Dependable

Capacity Test, the tested capacity is shown to be below the Dependable Capacity in effect prior to such test, the Dependable Capacity will be reduced to the newly tested capacity, and payments for the Dependable Capacity shall be decreased to the tested level, effective the Day Dependable Capacity Test is completed.

(c) Between annual tests, GPA may request one (1) additional Dependable Capacity Test (at Project Company's cost) if GPA reasonably believes that the currently set Dependable Capacity does not accurately reflect the Dependable Capacity previously declared to GPA. GPA shall provide written Notice of its request to test fourteen (14) Days prior to the requested test date. Project Company shall be entitled to one (1) retest of such Dependable Capacity Test (at Project Company's cost) before the level of capacity achieved during such a test is set as the Dependable Capacity provided that it rejects the test within twenty-four (24) hours of completing the Dependable Capacity Test. Each such Dependable Capacity Test and, as appropriate, any retest, shall be conducted in accordance with the foregoing Subsection (b), within ten (10) Days of its request or, as the case may be, the rejection, and Project Company shall give GPA not less than seventy-two (72) hours Notice of its intention to perform such retest.

(d) Between annual tests, Project Company may:

i. conduct one additional Dependable Capacity Test; and

ii. in addition to Project Company's right to request an additional Dependable Capacity Test under Article i above, conduct (at Project Company's cost) one additional Dependable Capacity Test if GPA has elected to conduct an additional Dependable Capacity test mentioned in Article 8.2 (c) during a Forced Outage,

in each case, if Project Company reasonably believes that the currently set Dependable Capacity does not accurately reflect the Dependable Capacity that the Facility is able to achieve.

Each such Dependable Capacity Test carried out pursuant to this Article 8.2(d) shall be conducted in accordance with Article 8.2(b) and Project Company shall give GPA not less than seventy-two (72) hours' Notice of its intention to perform each such Dependable Capacity Test.

(e) Notwithstanding anything to the contrary in this Agreement, no Dependable Capacity Test will be conducted during a Scheduled or Maintenance Outage, during the occurrence of a Force Majeure that affects the Facility, or while the consequences of such Force Majeure continue to affect the Facility. For the avoidance of doubt, the additional Dependable Capacity Test mentioned in Article 8.2(c) may be conducted during a Forced Outage.

(f) If GPA requires the Facility to operate on Natural Gas in accordance with the provisions of Article 4.4:

i. GPA shall issue a Notice to Project Company stating the date, which shall not be less than 60 Days from the date of the Notice, starting from which it could start the supply of Natural Gas;

ii. Project Company shall be allowed a period of twenty five (25) Days following the date set forth in the above-mentioned Notice to implement the switch to Natural Gas and to perform the tests set forth in Schedule 4;

iii. during such twenty five (25) Day period, which shall be extended in case of occurrence of any Force Majeure event or unavailability of Natural Gas:

(A) The Facility shall be deemed to provide the Dependable Capacity and the Project Company shall receive the full Capacity Charge;

(B) GPA shall provide sufficient quantities of Natural Gas in order to allow Project Company to implement the switch;

(C) Provision of Natural Gas by GPA to Project Company up to [ ] MMBtu of Natural Gas (the "**Maximum Natural Gas Switch Quantity**") shall be at GPA's cost;

(D) Provision of Natural Gas by GPA to Project Company in quantities exceeding the Maximum Natural Gas Switch Quantity shall be at Project Company's cost;

(E) and Project Company shall perform the tests referred to in Schedule 4 (at Project Company's cost) and shall be required to conduct (including after the expiry of such period) as many retests (at Project Company's cost) as necessary to pass these tests in accordance with the provisions of Schedule 4.

(g) The Parties agree that the provisions of paragraph (f) above shall only apply when GPA elects to burn Natural Gas for the first time during the Term.

(h) GPA shall have the right to request that the Facility's heat rate be tested (at Project Company's cost) concurrently with any Dependable Capacity Test and Project Company shall be obligated to comply with such request.

8.3 Notice of and Compliance with Testing Procedures

Project Company shall carry out Commissioning of Phase 1 and Phase 2, the testing of the Initial Dependable Capacity at or prior to the Phase 1 and Phase 2 Commercial Operation Dates and the testing of the Dependable Capacity of the Facility thereafter in accordance with Articles 8.2 and Schedule 4. GPA shall use its reasonable efforts to comply promptly with all reasonable requests made by Project Company for assistance in carrying out such testing and Commissioning. GPA shall be given prior Notice of the testing or Commissioning procedure in accordance with Article 8.2 and shall be entitled to be present and observe any such testing and Commissioning. The procedures and results of such Tests shall be certified by the GPA Engineer.

8.4 Copies of Test Results

Project Company shall provide GPA with copies of the results of all tests performed pursuant to Schedule 4 and after every Major Overhaul of a generating Unit at the Facility.

GPA shall not use or disclose such results other than in connection with the administration and enforcement of this Agreement or subject to applicable Law.

8.5 Deemed Commissioning

(a) In the event that for any reason (other than a breach by Project Company of its obligations under this Agreement or any other Project Agreement):

i. Due to (A) any action or inaction by GPA which is inconsistent with the terms of this Agreement (including any default or breach), [(B) the discovery of a Pre-Existing Site Condition, (C) any failure by GPA or any third party appointed by GPA to carry out remediation work in accordance with Article 6.6(c)] or (D) unavailability of Fuel, a Commercial Operation Test is delayed beyond the date falling fourteen (14) Days before the Required Phase 1 Commercial Operation Date or Required Phase 2 Commercial Operation date (whichever is applicable), then upon receipt of a certificate from an Independent Engineer to the effect that the Facility is, or would have been, ready for testing by the relevant Required Commercial Operation Date, the Facility shall be deemed Commissioned for the respective Phase fifteen (15) Days after the relevant Required Commercial Operation Date (provided that for the avoidance of doubt the Project Company shall in no event be required to pay delay liquidated damages under Article 9.1 for such fifteen (15) Day period) and the Facility shall be deemed to be providing Initial Dependable Capacity equal to the applicable Contracted Facility Capacity for the purposes of payments of Capacity Charges to be made by GPA to Project Company.

If the Facility has been deemed Commissioned for a Phase, the Commercial Operation Tests for such phase shall be conducted at the first available opportunity after such deemed Commissioning, and the Initial Dependable Capacity adjusted as a result of such test in accordance with subsection (b) below. Project Company shall use reasonable efforts to mitigate the delay caused by any of the events mentioned in this Article 8.5(a).

(b) In the event that the Initial Dependable Capacity of the Facility at the Commercial Operation Tests after the Phase has been deemed Commissioned, is less than the applicable Contracted Facility Capacity, Project Company shall refund to GPA an amount equal to:

i. the difference, if any, between the applicable Contracted Facility Capacity and the Initial Dependable Capacity divided by the applicable Contracted Facility Capacity; times

ii. the total Capacity Charges paid between the date of deemed Commissioning and the date upon which the Initial Dependable Capacity Tests take place; provided, however, that in the event that the Initial Dependable Capacity for Phase 2 is less than the Threshold Capacity, the Project Company shall refund all Capacity Charges received based on deemed Commissioning.

(c) If, due to a delay mentioned in Article 8.5(a), either or both of the actual Phase 1 Commercial Operation Date or the actual Phase 2 Commercial Operation Date does not occur within one (1) month of the relevant Required Commercial

Operation Date, GPA shall indemnify Project Company for (i) the actual reasonable documented costs of demobilisation and remobilisation of personnel of Project Company, the O&M Contractor and of the Construction Contractor, and (ii) for any other actual reasonable documented costs payable to the Construction Contractor.

ARTICLE 9
LIQUIDATED DAMAGES PAYABLE BY PROJECT COMPANY

9.1 Delay in Commissioning

Project Company covenants that Phase 1 shall be Commissioned on or before the Required Phase 1 Commercial Operation Date. If the Phase 1 Commercial Operation Date has not occurred by the Required Phase 1 Commercial Operation Date, the Project Company shall pay GPA, as liquidated damages, for the delay in Phase 1 Commissioning a sum equal to US$240,000 for each Day of delay or fraction thereof. With respect to any day after the Required Phase 2 Commercial Operation Date, Project Company will not be liable for Phase 1 delay liquidated damages to the extent it is paying Phase 2 delay liquidated damages for such day.

Project Company covenants that Phase 2 shall be Commissioned on or before the Required Phase 2 Commercial Operation Date. If the Phase 2 Commercial Operation Date has not occurred by the Required Phase 2 Commercial Operation Date, the Project Company shall pay GPA, as liquidated damages, for the delay in Phase 2 Commissioning a sum equal to US$240,000 for each Day of delay or fraction thereof.

In no event shall the damages assessed under this Article 9.1 exceed [US$40,000,000].

9.2 Failure to Meet Contracted Facility Capacity

(a) Project Company covenants that the Initial Dependable Capacity of Phase 1 shall not be less than the Contracted Phase 1 Capacity. In the event that upon completion of the Dependable Capacity Test used to establish the Initial Dependable Capacity of Phase 1 at or prior to the Phase 1 Commercial Operation Date, pursuant to Article 8, the Initial Dependable Capacity for Phase 1 is less than the Contracted Phase 1 Capacity, Project Company shall have the option for a period of up to six (6) months from the Phase 1 Commercial Operation Date to undertake any necessary actions ("**Remedial Actions**") to increase the Initial Dependable Capacity to the Contracted Phase 1 Capacity at its own cost. Within 15 Days of the expiration of such period or any decision by Project Company not to undertake Remedial Actions (whichever is the earlier to occur), Project Company shall pay to GPA, as liquidated damages, an amount equal to US$280 per kW of the shortfall between the most recently determined Initial Dependable Capacity and the Contracted Phase 1 Capacity.

(b) Project Company covenants that the Initial Dependable Capacity of Phase 2 shall not be less than the Contracted Phase 2 Capacity. In the event that upon completion of the Dependable Capacity Test used to establish the Initial

Dependable Capacity of Phase 2 at or prior to the Phase 2 Commercial Operation Date, pursuant to Article 8, the Initial Dependable Capacity for Phase 2 is less than the Contracted Phase 2 Capacity (but greater than the Threshold Capacity), Project Company shall have the option for a period of up to six (6) months from the Phase 2 Commercial Operation Date to undertake Remedial Actions to increase the Initial Dependable Capacity to the Contracted Phase 2 Capacity at its own cost. Within 15 Days of the expiration of such period or any decision by Project Company not to undertake Remedial Actions (whichever is the earlier to occur), Project Company shall pay to GPA, as liquidated damages, an amount equal to US$3,100 per kW of the shortfall between the most recently determined Initial Dependable Capacity and the Contracted Phase 2 Capacity.

(c) In no event shall the damages assessed under this Article 9.2 exceed [US$ 35,000,000].

(d) Results of all Initial Dependable Capacity Tests and Dependable Capacity Tests shall be valid only to the extent such tests are performed while the Facility operates within the requirements of all Government Authorizations and the environmental permits.

9.3 Excessive Outages

(a) Excessive Forced Outages

Project Company covenants that, in respect of each Contract Year, the Excessive Forced Outages Energy ("**EFOE**") for such Contract Year shall be less than or equal to zero (0).

In the event that, during any Contract Year other than the first Contract Year, the Excessive Forced Outages Energy is greater than zero (0), then Project Company shall pay to GPA, as liquidated damages, the Capacity Damages, calculated as follows:

Capacity Damages (US$) =

Capacity Damages Amount (US$/MW) x 1.4 x Excessive Forced Outages Energy (MWh)/ eight thousand seven hundred sixty (8760) hours)

Where the Capacity Damages Amount equals the product of (i) the Capacity Charge per MW per Month prevailing during the relevant Contract Year and (ii) 12 Months.

i. The Excessive Forced Outages Energy (EFOE) for any Contract Year, other than as modified in Article 9.3 for the first Contract Year, will be the sum of the actual Forced Outages (FOE) minus the Allowable Forced Outages Energy (AFOE), , namely:

Excessive Forced Outages Energy (MWh) = [FOE – (AFOE)] (each term expressed in MWH)

FOE (MWh)	=	the summation of all periods of Forced Outage of this product: duration of outage (hours) x reduction in Dependable Capacity (MW).
AFOE (MWh)	=	Annual Average Dependable Capacity (MW) x [insert guaranteed maximum forced outage hours included in Bidder's Proposal] hours.

ii. If the EFOE for any Contract Year is less than or equal to zero, no liquidated damages are due.

(b) Excessive Total Outages

Project Company covenants that, in respect of each Contract Year, the Excessive Total Outages Energy ("**ETOE**") for such Contract Year shall be less than or equal to zero (0).

In the event that, during any Contract Year other than the first Contract Year, the Excessive Total Outages Energy is greater than zero (0), then Project Company shall pay to GPA, as liquidated damages, the Capacity Damages, calculated as follows:

Capacity Damages (US$) =

Capacity Damages Amount (US$/MW) x 1.4 x Excessive Total Outages Energy (MWh)/ eight thousand seven hundred sixty (8760) hours)

Where the Capacity Damages Amount equals the product of (i) the Capacity Charge per MW per Month prevailing during the relevant Contract Year and (ii) 12 Months.

i. The Excessive Total Outages Energy (ETOE) for any Contract Year, other than as modified in Article 9.3 for the first Contract Year, will be the sum of the actual total outages (FOE, MOE and SOE) minus the Allowable Total Outages Energy (ATOE), minus the difference between the Forced Outages (FOE) and the Allowable Forced Outages Energy (AFOE), namely:

Excessive Total Outages Energy (MWh) = [FOE + MOE + SOE - (ATOE)] - [FOE – (AFOE)]
(each term expressed in MWH)

FOE (MWh)	=	the summation of all periods of Forced Outage of this product: duration of outage (hours) x reduction in Dependable Capacity (MW).
MOE (MWh)	=	the summation of all periods of Maintenance Outage of this product: duration of outage (hours) x reduction in Dependable Capacity (MW).
SOE (MWh)	=	the summation of all periods of Scheduled Outage of this product: duration of outage (hours) x reduction in Dependable Capacity (MW).
ATOE (MWh)	=	Annual Average Dependable Capacity (MW) x [insert guaranteed maximum total outage hours pursuant to the availability guarantee included in Bidder's Proposal] hours.
AFOE (MWh)	=	Annual Average Dependable Capacity (MW) x [insert guaranteed maximum forced outage hours pursuant to the forced outage rate guarantee included in Bidder's Proposal] hours.

ii. If the ETOE for any Contract Year is less than or equal to zero, no liquidated damages are due.

9.4 Failure to Meet Guaranteed Amount of Renewable Energy

If the Facility is a hybrid Facility, the Project Company guarantees that, for each Contract Year, the Net Energy Output derived from the Renewable Component shall be equal to or greater than the Guaranteed Amount of Rewable Energy. After the end of each Contract Year, GPA shall verify the amount of Net Energy Output derived from the Renewable Component for such year and if it is less than the Guranteed Amount of Renewable Energy applicable to such year, the Project Company shall be liable for Renewable Component Liquidated Damages which shall be payable as part of the next monthly invoice. Renewable Component Liquidated Damages shall be equal to the amount of the annual shortfall (in kWh) multiplied by the average Energy Charge (in $/kWh) for the applicable Contract Year.

9.5 Waiver of Defences

Notwithstanding that GPA may be substantially damaged in amounts that may be difficult or impossible to determine in the event that a Phase or Renewable Component (i) is not Commissioned by the date required, (ii) is not capable of achieving and maintaining the Contracted Phase 1 Capacity or the Contracted Facility Capacity or the Guaranteed Amount of Renewable Energy, (iii) cannot minimise the number of Forced Outages, or (iv) cannot achieve the designated operating levels, the Parties agree that the sums set out in this Article 9 constitute a genuine pre-estimate of the loss to GPA and as a result are

fair and reasonable as liquidated damages and it is further understood and agreed that the payment of liquidated damages is in lieu of actual damages for such occurrences. Project Company hereby waives any defence as to the validity of any liquidated damages in this Agreement on the grounds that such damages are void as penalties.

9.6 Financial Close and Security Deposits

(a) Notice of Possible Delays to Financial Close

Project Company shall, promptly (and in no event later than seven (7) Days after becoming aware thereof) give written notice to GPA of the occurrence of any event which delays, or is reasonably likely to delay, Financial Close beyond the Required Financial Closing Date. Within fourteen (14) Days after any such initial notice, Project Company shall provide GPA with a further written notice substantiating such occurrence in reasonable detail, its effect on Project Company's ability to achieve Financial Close, and its effects, if any, on the Project, including financial implications. Further, Project Company shall thereafter provide such further information and updates as GPA may reasonably request from time to time in order to substantiate such occurrence and/or such effects.

(b) Extension of Required Financial Closing Date

If Project Company does not achieve Financial Close by the Required Financial Closing Date due to reasons other than an Excusable Event or other than Project Company's failure, then the Required Financial Closing Date shall be extended until the date that is ninety (90) Days after the original Required Financial Closing Date, provided that prior to any such extension, the validity period of the Bid Guarantee shall have been extended (by written amendment thereto delivered to GPA) until the extended Required Financial Closing Date.

(c) Failure to Achieve Financial Closing

In the event that Project Company fails to achieve Financial Close by the Required Financial Closing Date or extended Required Financial Closing Date, either Party may terminate this Agreement. In the event of such termination, GPA shall be entitled to cash the Bid Guarantee, in which event neither Party shall have any further liability or obligation to the other under this Agreement, except for liabilities accrued hereunder prior to or upon such termination (including liability for any breach of this Agreement by the Project Company).

(d) Financial Closing

At Financial Close, GPA shall return the Bid Guarantee to Project Company and Project Company shall provide to GPA a security deposit (the "**Performance Bond**") in an amount in Dollars equal to US$75,000,000 to ensure Project Company's obligations to pay liquidated damages in accordance with Articles 9.1 and 9.2. The Performance Bond shall terminate three (3) Months after the Phase 2 Commercial Operation Date (or, in the case that Project Company opts to pursue Remedial Actions, six (6) months thereafter), at which point GPA shall return the Performance Bond to Project Company. The Performance Bond shall consist of either: (i) an unconditional and irrevocable direct pay letter of credit issued by an international bank with an investment grade rating in form

and substance reasonably acceptable to GPA; (ii) a bank guarantee issued by an international bank with an investment grade rating in form and substance reasonably acceptable to GPA; or (iii) a performance bond issued by an international surety with an investment grade rating in form and substance reasonably acceptable to GPA.

9.7 Payments of Liquidated Damages

(a) Within fourteen (14) Days after the end of (i) each Month in respect of amounts due pursuant to Articles 9.1 and 9.2, and (ii) each Contract Year in respect of amounts due pursuant to Article 9.3 and 9.4, GPA shall compute and advise Project Company by Notice (a "**Liquidated Damages Notice**") of the amount of liquidated damages, if any, due to GPA pursuant to this Agreement for the preceding Month or Contract Year, as the case may be. Subject to Article 9.7(b), Project Company shall pay to GPA the amount of liquidated damages shown on the Liquidated Damages Notice within ten (10) Business Days of the date of the Liquidated Damages Notice (the "**Liquidated Damages Due Date**"). If Project Company fails to pay any amount due pursuant to Article 9.1, 9.2, 9.3, and 9.4 by the Liquidated Damages Due Date, GPA shall be entitled to draw such amount from the Performance Bond. Interest shall accrue on any unpaid and undrawn amount from the Liquidated Damages Due Date until the date payment is made at the rate of the Bank Rate. Save to the extent that the amount of liquidated damages reflected on the Liquidated Damages Notice is paid to GPA by Project Company or, with respect to liquidated damages pursuant to Article 9.1, 9.2, 9.3, and 9.4, drawn from the Performance Bond, the amount of liquidated damages pursuant to Article 9.1, 9.2, 9.3, or 9.4 plus accrued interest due to GPA may be set off against amounts owed to Project Company by GPA on the next statement(s) submitted to GPA pursuant to Article 14.

(b) In the event of any Dispute as to the computation or payment of liquidated damages, Project Company shall provide Notice to GPA specifying the amount disputed and the reason therefor. In such event, the amounts not disputed shall be paid as described in this Article 9 and the Dispute shall be settled in accordance with the Dispute resolution procedures set forth in Article 19. If any such Dispute is resolved in favor of GPA, the determination of amounts due to GPA shall include interest at the rate specified for late payment in Article 9.7(a). Upon resolution, the Project Company shall pay the amount determined to be owed to GPA within ten (10) Days of such resolution, failing which GPA shall be entitled to claim such amount from the Performance Bond, as applicable.

ARTICLE 10
CONTROL AND OPERATION OF THE FACILITY

10.1 Operating Procedures

The Facility shall be operated and maintained in accordance with the Operating Procedures.

10.2 Dispatch

(a) The PSCC will issue Dispatch Instructions to establish the Net Energy Output that the Facility is expected to feed into the Grid System during forthcoming periods of time. In coordination with GPA, Project Company shall be responsible for determining the operating modes (including but not limited to the determination of how to load each Unit) that will result in the most efficient and reliable operation.

(b) Project Company shall notify GPA and the PSCC whenever a Dispatch Instruction results in a part of or the whole Facility being operated beyond the Technical Limits. Project Company never has an obligation to operate and GPA never has a right to dispatch the Facility beyond the Technical Limits. The Operating Procedures shall establish the circumstances under which Project Company will trip a Unit, prior to such Unit being tripped by a protective device.

(c) Dispatch Instructions shall indicate the total amount of Net Energy Output required during the relevant period, expressed as an amount in MW, which amount may not exceed the Declared Capacity unless and to the extent Excess Energy is available.

10.3 Scheduling of Capacities and Energy

GPA and Project Company shall cooperate in establishing the following scheduling for the Facility's Dependable Capacity and Net Energy Output:

(a) Year-Ahead Notification: Not less than ninety (90) Days before the scheduled Commercial Operation Date for a Phase and thereafter not less than ninety (90) Days before the beginning of each Contract Year, GPA shall provide to Project Company good faith estimates of its requirements on a Monthly basis, for the Net Energy Output and the maximum capacity required during that Contract Year, but shall not be bound by those figures. GPA will also indicate the desired maintenance periods for the upcoming Contract Year.

(b) Quarter-Ahead Notification: Not less than sixty (60) Days before each quarter of each Contract Year, GPA shall provide to Project Company good faith estimates of its requirements, on a week-by-week basis for the Net Energy Output and maximum capacity required during that quarter and also provisionally for the following quarter, but shall not be bound by those figures.

(c) Month-Ahead Notification: Not less than fourteen (14) Days before each Month, GPA shall provide to Project Company good faith estimates of its requirements on a day-by-day basis, for the Net Energy Output and maximum capacity required during that Month and also provisionally for the following Month, but shall not be bound by those figures.

(d) Week-Ahead Notification: Not later than 12:00 noon on Thursday before each week beginning on each Saturday, GPA shall:

(i) provide Project Company estimated requirements, on an hour by hour basis, for the Net Energy Output and maximum capacity required during that week and also provisionally, during the following week, but shall not be bound by these figures; and

(ii) determine which Fuel shall be used each hour during that week.

(e) Declared Capacity Notification: To enable GPA to give final schedules of requirements, Project Company shall notify the PSCC, by 8:00 a.m. each Day, of the Declared Capacity available during each hour of the following Day. However, Project Company may notify the PSCC, not less than twelve (12) hours prior to its scheduled occurrence, of any reasonable modification to the Declared Capacity schedule. The Notices that Project Company is required to send to GPA pursuant to this Article 10.3(e) shall include the number of MW available for each Unit during each hour of the following day and the amount and type of Fuel required to comply with the expected dispatch. The availability of the Facility shall be based, for the purposes of determining the Declared Capacity or calculating Outage Hours, on the availability of the Facility with the Fuel that GPA instructs the Project Company to run.

(f) Day-Ahead Notification: Not less than 8 hours before the start of each Day the PSCC shall provide to Project Company firm requirements in accordance with Article 10.2(c), on an hour-by-hour basis for capacity during that Day and also, provisionally, during the following Day. The firm requirements shall be binding upon GPA; provided, however, Project Company shall not unreasonably withhold its consent to any reasonable request from GPA for an alteration to its requirements.

(g) Information Related to Renewable Component: Project Company shall provide the PSCC with [real time] updates of the current production and the seven (7) day hourly production forecast for the Renewable Component.

(h) The methods for scheduling the capacity may be modified from time to time. Such modifications may be initiated by GPA, the PSCC, or Project Company and must be approved by the Joint Coordinating Committee.

10.4 Scheduled Maintenance.

(a) Project Company shall submit its desired schedule of Scheduled Outage periods (including the duration of each such period) to GPA six (6) months before the Required Phase 2 Commercial Operation Date and thereafter on [ ] 1st of each calendar year. Project Company shall use commercially reasonable efforts to schedule any Scheduled Outage periods during the period from [insert applicable month] to [insert applicable month] only or such other alternative periods as GPA may specify, provided that GPA does specify at least one (1) year in advance the alternative period and that the period available for Scheduled Outages is of equal duration to the period specified herein. Within thirty (30) Days of receipt of such schedule, GPA shall notify Project Company in writing as to the acceptability of such schedule. Project Company shall use all reasonable efforts to make each such Scheduled Outage period of relatively short duration consistent with the Technical Limits, Prudent Utility Practices, and the recommendations of the manufacturers of the various components of the Facility. The Project Company shall use all reasonable efforts to perform maintenance of equipment connected with photovoltaic solar production between the hours of [8:00pm and 6:00am].

(b) If GPA does not accept any one or more of the requested Scheduled Outage(s) periods, GPA shall advise Project Company within thirty (30) Days of the receipt

of Project Company's notification in accordance with sub-section (a) above of the acceptable period when GPA determines any such unacceptable Scheduled Outage can be rescheduled. The rescheduled time shall be as close as reasonably practicable to the requested time, shall be consistent with the Technical Limits, Prudent Utility Practices and the recommendations of the manufacturers of the various components of the Facility, and shall be of the same duration as the requested period. If GPA fails within such thirty (30) Day period to object to any Scheduled Outage for which it receives Notice pursuant to subsection (a) above or fails within such period to advise Project Company of a substitute time, Project Company may schedule and conduct the Scheduled Outage(s) as initially requested.

(c) Project Company shall schedule Scheduled Outages only at times determined as aforesaid; provided, however, that GPA may not require Project Company to schedule Scheduled Outages in a manner or time which is outside the Technical Limits, is inconsistent with Prudent Utility Practices or the recommendations of the manufacturers of the various components of the Facility.

(d) Notwithstanding the fixing of a time for a Scheduled Outage pursuant to subsections (a), (b) and (c) above, GPA may, upon at least ninety (90) Days prior Notice and upon agreeing to pay the documented increased cost, if any, to the Project Company resulting therefrom, require Project Company to reschedule a Scheduled Outage; provided, however, (i) GPA shall not require such Scheduled Outage to be rescheduled for a period of shorter or longer duration or in a manner or time that is outside the Technical Limits, or inconsistent with Prudent Utility Practices or the recommendations of the manufacturers of the various components of the Facility, (ii) GPA shall not require that a single Scheduled Outage period be split into two or more periods without compensating Project Company for any additional costs incurred thereby, and (iii) GPA shall not require that a Scheduled Outage be brought forward any earlier than sixty (60) Days from the date of such Notice without the consent of Project Company.

(e) Notwithstanding the fixing of a time for a Scheduled Outage pursuant to sub sections (a), (b) and (c) above, Project Company may request a rescheduling of any Scheduled Outage upon ninety (90) Days prior written Notice to GPA. GPA shall respond to such request within ten (10) Business Days and shall not unreasonably withhold its permission for such rescheduling.

(f) When the need arises for a Maintenance Outage, Project Company shall advise GPA of such need and of the commencement and estimated duration of such work, and GPA shall allow Project Company to schedule such Maintenance Outage within a period of time that is reasonable under the circumstances, but in any event not to exceed the time required by the Technical Limits and Prudent Utility Practices. Project Company shall use all reasonable efforts to conduct such Maintenance Outage during off-peak hours, provided, however, that with respect to equipment used for photovoltaic solar production, the Project Company shall use all reasonable efforts to perform maintenance between the hours of [8:00pm and 6:00am]. Project Company may advise GPA orally of the above matters set forth in this subsection (f), and GPA shall respond orally within twenty-four (24) hours of such notice. GPA shall confirm its communication in writing within one (1) week of such oral notice.

(g) For those years in which Project Company plans to conduct a Major Overhaul, Project Company shall submit its Major Overhaul schedule (including the number of Units subject to Major Overhaul and outage duration of each Unit for such period) to GPA, for each Contract Year, one year in advance by Notice. It is expected that a Major Overhaul will take place approximately every [ ] operating hours, both as defined by the manufacturer and will not exceed [ ] Days in any Contract Year. Project Company shall use commercially reasonable efforts to not schedule a Major Overhaul during the months of [insert month] through [insert month] inclusive. Within thirty (30) Days of receipt of this schedule, GPA shall notify Project Company in writing as to the acceptability of such schedule. If GPA does not accept this schedule, GPA shall advise Project Company within thirty (30) Days of receipt of such Schedule of the time when GPA determines the Major Overhaul can be rescheduled. The rescheduled time shall be as close as reasonably practicable to the requested time, shall be consistent with the Technical Limits, Prudent Utility Practices, and the recommendations of the manufacturers of the various components of the Facility, and shall be of equal duration as the requested period. If GPA fails within the allowed period to object to any Major Overhaul for which it receives Notice pursuant to this Article, or fails within such period to advise Project Company of a substitute time, Project Company may schedule the Major Overhaul as initially requested.

10.5 Emergencies

(a) Project Company shall cooperate with GPA in establishing agreed Emergency plans for the Facility at least ninety (90) Days before the Required Phase 1 Commercial Operation Date, including recovery from a local or widespread electrical blackout and voltage reduction in order to curtail load.

(b) On or after the Phase 1 Commercial Operation Date, Project Company shall, during an Emergency, within no more than fifteen (15) minutes of GPA's request, and more quickly if possible consistent with Prudent Utility Practices, supply such power as the Facility is able to generate; provided, however, that Project Company shall not be obligated to operate the Facility beyond the Technical Limits or beyond the limits which Project Company reasonably believes could result in a trip. If a Scheduled Outage or Maintenance Outage occurs or would occur coincident with an Emergency, Project Company, upon consultation with GPA and at GPA's sole cost and expense, shall make all reasonable efforts to reschedule the Scheduled Outage or Maintenance Outage or, if the Scheduled Outage or Maintenance Outage has begun, expedite the completion of the work to restore power supply as soon as possible.

10.6 Maintenance of Operating Records

(a) Each Party shall keep complete and accurate records and all other data required by each of them for the purposes of proper administration of this Agreement. Among, but not limited to, other records and data required hereby or elsewhere in this Agreement, Project Company shall maintain an accurate and up-to-date operating log at the Facility with records of:

i. Net Energy Output production for each demand period and Delivery Point, and bus voltage at all times (for this purpose Project Company shall install

a computerized system that will maintain an agreed data base of all pertinent parameters, as determined by the Joint Coordinating Committee).

ii. Changes in operating status, Scheduled Outages, Maintenance Outages and Forced Outages; and

iii. Any unusual conditions found during inspections.

(b) All such records required under Article 10.6(a) shall be maintained for a minimum of sixty (60) Months after the creation of such record or data; provided, however, that the Parties shall not dispose of or destroy any such records after such sixty (60) Month period without thirty (30) Days' prior Notice to the other Party. Either Party shall have the right, upon reasonable prior Notice to the other Party, and at reasonable times during normal office hours, to examine the records and data of the other Party relating to this Agreement or the operation and dispatch of the Facility within the Grid System at any time during the period such records and data are required hereunder to be maintained.

10.7 Annual Report

Project Company shall deliver to GPA an annual operating and maintenance report for each Contract Year, within two (2) Months following the expiration of each Contract Year. Such annual report must include the operation and maintenance report for the prior year and the anticipated operation and maintenance plan and Emergency plan for the upcoming year.

10.8 Facility Improvements

Subject to the prior written consent of Project Company and the Agent (in accordance with the Lenders' Direct Agreement), if Project Company shall be requested by GPA to (a) increase the generation capacity of the Facility or (b) add equipment, then Project Company shall (once all relevant details have been agreed by Project Company and GPA) implement and prosecute such request at GPA's expense.

Notwithstanding the first sentence of this Article 10.8, the Project Company shall not prosecute and implement such request until:

(a) GPA and the Project Company shall have agreed on the feasibility, schedule and cost of such implementation and additional construction (if any), with capital costs and operational costs being recoverable through Supplemental Charges or by direct cost-plus reimbursement at the discretion of the Project Company;

(b) the financing for such implementation and construction (if any) has been obtained; and

(c) appropriate adjustments to the Price (if any), including the Capacity Charge and the Energy Charge, have been agreed, and taking into account any lost revenue due to necessary Facility outages and all other costs or Losses to be

incurred by Project Company consequent upon implementation of such changes.

10.9 Reactive Power

If, due to instability in the Grid System, GPA requests Project Company to operate the Facility in a power factor range outside the range mentioned in Schedule 2, Project Company shall comply with such request, provided that (i) it shall not have any obligation to operate the Facility in such a way for more than 1 hour at a time if, in the opinion of Project Company, it could damage the Facility and (ii) Project Company shall never be required to operate the Facility in a manner that is inconsistent with the Functional Specifications or the Technical Limits and the Contracted Characteristics.

10.10 GPA Acces to Site

Project Company shall allow GPA to have reasonable access to the Site subject to prior notice by GPA. GPA personnel will be required to comply with all Project Company safety rules and procedures when accessing the site.

GPA will be allowed to access the on-site ULSD Storage Facilities, without the need for prior notice, to fuel GPA's tanker trucks at no charge.

10.11 Employment of former GPA Employees by the Project Company

GPA power facilities maintenance and operations employees who may be adversely affected or separated as a result of the commissioning of the Project, shall be granted a right of first refusal by the Project Company for employment at the Facility in positions for which they are qualified. For each case of hiring an existing GPA maintenance and/or operating employee, the Project Company shall advise GPA of their plan for hiring such employee and allow a minimum of six [6] months before beginning the employment period to allow GPA to adjust its' plant operation and maintenance activities. If requested by GPA, Project Company will make reasonable efforts to assist GPA with finding a temporary labor pool for positions at their existing power plants that will be vacated by personnel hired by the Project Company.

ARTICLE 11
JOINT COORDINATING COMMITTEE

11.1 Membership

Within ninety (90) Days from the date of this Agreement, the Parties shall establish a Joint Coordinating Committee of ten (10) members, with Project Company and GPA each appointing five (5) members. Each Party shall also appoint two (2) substitutes for each of its members. The substitutes must be appointed at least thirty (30) Days prior to being able to substitute for one of the members. Substitutes may attend the Joint Coordinating Committee meetings but cannot participate in them unless they are replacing a regular member.

The Joint Coordinating Committee shall meet at least once per month.

The chairmanship of the Joint Coordinating Committee shall rotate each year between the Parties, and the first chairman shall be appointed by GPA. The Joint Coordinating

Committee shall develop procedures for holding meetings, keeping minutes of meetings, maintaining records and appointing and operating sub-committees as may be required.

11.2 Duties

The power and duties of the Joint Coordinating Committee shall include only the following:

(a) coordination of the respective programs of the Parties for the permitting, design, construction and Commissioning of the Facility, the Fuel supply and transportation interfacing, and the Electrical Interconnection Facilities, and agreement where necessary upon the respective Commissioning procedures;

(b) discussion of the steps to be taken upon shutdown or reduction in capacity for Force Majeure or any other reason;

(c) coordination and modification, if required, of Operating Procedures, including day-to-day communications, dispatching procedures, and Emergency plans and procedures, and compliance with Operating Procedures;

(d) coordination and modification, if required, of scheduled maintenance programs and scheduling and acceptance of performance tests and periodic tests;

(e) review of maintenance records, including results of periodic tests, for compliance with manufacturers' maintenance instructions and recommendations;

(f) coordination of annual, monthly, weekly, and daily forecasts or requirements for the Facility;

(g) developing, monitoring, and auditing the procedures to record Dependable Capacity, reliability, Net Energy Output, and any other parameters that may influence the billing or liquidated damages arising from operation;

(h) developing protocols for invoicing and for measuring Dependable Capacity and Net Energy Output;

(i) developing detailed procedures with respect to Natural Gas (when available) daily nominations and renominations based on Dispatch Instructions, ambient conditions for the next day and data provided in the tables entitled "Guaranteed Heat Rates at Guaranteed Conditions" and "Guaranteed Heat Rate Correction Curve" contained in Schedule 5;

(j) dealing with safety and security matters affecting the Facility, the Parties, and their Contractors;

(k) consultation on Emergency plans developed by the Parties for recovery from a local or widespread electrical blackout;

(l) review of metering and protective schemes and devices; and

(m) any other matter agreed by the Parties affecting the operation of the Facility and the Grid System.

11.3 Scope and Effect

The Parties agree and acknowledge that the jurisdiction of the Joint Coordinating Committee shall be limited to liaison and consultation only and that any decisions or agreements of the committee shall not be binding upon the Parties absent express written agreement to the contrary. The resolutions, considerations and discussions taking place from time to time within the Joint Coordinating Committee shall at all times remain subject to the express provisions of this Agreement, and, accordingly the respective rights and obligations of the Parties under this Agreement (or otherwise) shall not be affected by Articles 11.1 to 11.2.

11.4 Special Reporting

During any period in which either of the six (6) Month periods mentioned in Article 5.2(g) or Article 5.2(h) are extended in accordance with Article 5.2(g) and Article 5.2(h), as applicable, the Joint Coordinating Committee will meet every fourteen (14) Days and the members of the Joint Coordinating Committee appointed by Project Company will report on the status of the measures taken by Project Company to cure the deficiency.

ARTICLE 12
ELECTRICAL INTERCONNECTION

12.1 Electrical Interconnection Facilities

The Electrical Interconnection Facilities shall be designed, procured, and constructed by Project Company. Upon achieving the Phase 1 Commercial Operation Date and GPA's written acceptance thereof, the ownership, custody and control of the Electrical Interconnection Facilities shall be transferred by Project Company to GPA, after which the latter will operate and maintain the facilities in accordance with Prudent Utility Practices and the applicable system grid code at no cost to the Project Company. The transfer of the Electrical Interconnection Facilities shall be at no cost to GPA.

12.2 Testing

The Parties shall cooperate in testing the Electrical Interconnection Facilities from time to time prior to the scheduled synchronization dates of each Phase and at such other times thereafter as either Party may reasonably require. All such testing shall be carried out on a timely basis.

ARTICLE 13
METERING

13.1 Electrical Metering

The standards for performance measurement systems and testing are specified in Schedule 6.

(a) All electrical metering devices used to measure Net Energy Output pursuant to this Agreement, and to monitor and coordinate operation of the Facility, shall be purchased, owned, installed and maintained by Project Company according to the specifications in Schedule 6. All electrical metering will be done jointly by the Parties, and each Party shall designate a representative for performing such metering. All electrical metering devices used to provide data for the

computation of payments due under this Agreement shall be sealed, and the seal shall be jointly broken by the designated representatives of the Parties when such metering devices are to be inspected and tested or adjusted in accordance with Article 13.1(b) below. The number, type and location of such electrical metering devices shall be on the 115 kV high voltage bushings of the main power transformers and according to the single line diagram presented by Project Company and approved by GPA.

(b) Project Company shall inspect, test, and calibrate all electrical metering devices upon installation and at least once every five (5) years thereafter. Project Company shall provide GPA with reasonable advance Notice of, and allow a representative of GPA to witness and verify such inspections, tests, and calibrations. Upon the written request by GPA, and in the presence of GPA, Project Company shall perform additional inspections, tests, or calibrations of the electrical metering devices within twenty (20) Days following the date of such written request. The actual expense of any such requested additional inspection, tests, or calibration shall be borne by GPA, unless, upon such inspection, tests or calibration, a metering device is found to register inaccurately by more than 0.2%, in which event the expense of the requested additional inspection or testing shall be borne by Project Company. If an electrical metering device is found to be defective or inaccurate, whether or not within the accuracy and repeatability tolerances set forth in Table 6.1 of Schedule 6, Project Company shall, at its own expense, adjust, repair, replace, and/or recalibrate the electrical metering device as near as practicable to a condition of zero error.

(c) GPA may elect to install and maintain, at its own expense, back-up electrical metering devices at the Delivery Point in addition to (and identical to) those installed and maintained by Project Company, which installation and maintenance by GPA shall be in a manner reasonably acceptable to Project Company.

13.2 Adjustment for Inaccurate Electrical Meters.

If an electrical metering device fails to register, or if the measurement made by a metering device is found upon testing to be inaccurate, an adjustment shall be made correcting all measurements by the inaccurate or defective electrical metering device for the Project for the amount of the inaccuracy and the period of the inaccuracy, in the following manner:

(a) By (i) integrating the capacity measurements obtained by the MW-meter readings which are registered every thirty (30) minutes in the PSCC, or (ii) by using the Declared Capacity, whichever is applicable; or

(b) As may be agreed upon by the Parties; or

(c) In the event that the Parties cannot agree on the amount of the adjustment necessary to correct the measurements made by any inaccurate or defective electrical metering device, the Parties shall use GPA's back-up electrical metering device, if installed, to determine the amount of such inaccuracy; so long as such electrical metering devices are tested and maintained in the same manner as Project Company's. In the event GPA's back-up electrical metering devices are also found to be outside the accuracy and repeatability tolerances set forth in Table 6.1 of Schedule 6, as are applied to Project Company's electrical metering

devices under Article 13.1(b) above, the Parties shall estimate the amount of the necessary adjustment on the basis of deliveries of Net Energy Output during periods of similar operating conditions when the electrical metering device was registering accurately.

(d) In the event that the Parties cannot agree on the actual period during which the inaccurate measurements were made, the period during which the measurements are to be adjusted shall be the shorter of (i) the last one-half of the period from the last previous test of the electrical metering device, or (ii) the (120) Days immediately preceding the test which found the electrical metering device to be defective or inaccurate.

To the extent that the adjustment period covers a period of deliveries for which payment has already been made by GPA, GPA shall use the corrected measurements as determined in accordance with Article 13.2(a), (b), (c), or (d) hereof to recompute the amount due for the period of the inaccuracy and shall subtract the previous payments by GPA for this period from such recomputed amount. If the difference is a positive number, the difference shall be paid by GPA to Project Company. If the difference is a negative number, the difference shall be paid by Project Company to GPA, or in the sole discretion of GPA, the difference may take the form of an offset to payments due to Project Company by GPA. Payment of such difference by the owing Party shall be made not later than thirty (30) Days after the owing Party receives Notice of the amount due, unless GPA elects payment via an offset.

13.3 Natural Gas Metering

(a) Natural Gas Metering Equipment

i. GPA at its cost shall be responsible to install and maintain primary Natural Gas measurement equipment at the gas metering station in the Natural Gas pipelines supplying Natural Gas to the Facility in accordance with Schedule 6. GPA shall read its meter(s) at that point and such readings shall be considered official meters.

ii. Project Company may install Natural Gas backup measurement equipment downstream of GPA's measurement equipment for Natural Gas. In such case, Project Company shall be responsible for installing and maintaining the Natural Gas backup measurement equipment.

iii. GPA's Natural Gas metering devices shall be inspected, tested, and calibrated by GPA at least once each three (3) years. If Project Company at any time desires a special test of any meter or the computer used in the operation of the GPA's Natural Gas metering devices, it will promptly notify GPA and the Parties will then co-operate to secure a prompt test. All tests of GPA's Natural Gas metering devices shall be made at GPA expense, except that Project Company shall bear the GPA's reasonable cost of special tests made at the Project Company's request if the inaccuracy is found to be within 1%. Following each test, GPA shall ensure that GPA's Natural Gas metering devices shall be adjusted as required to record centrally and accurately.

iv. Project Company's Natural Gas metering devices shall be inspected, tested, and calibrated by Project Company at least once each three (3) years. If GPA at any time desires a special test of any meter or the computer used in the operation of Project Company's Natural Gas metering devices, it will promptly notify Project Company and the parties will then co-operate to secure a prompt test. All tests of Project Company's Natural Gas metering devices shall be made at Project Company's expense, except that GPA shall bear Project Company's reasonable cost of special tests made at GPA's request if the inaccuracy is found to be within 1%. Following each test, Project Company shall ensure that Project Company's Natural Gas metering devices shall be adjusted as required to record centrally and accurately.

(b) Adjustment for Inaccurate Natural Gas Meters.

i. If, for any reason, GPA's Natural Gas meters are out of service or registering outside the specified limits, so that the quantity of Natural Gas delivered cannot be ascertained or computed from the reading thereof, the Natural Gas delivered during the period such meters are out of service shall be determined upon the basis of the best data available, using the first of the following methods which is feasible:

(A) By using the quantity recorded by Project Company's Natural Gas meters, if installed and accurately registering;

(B) By adjusting for the error, if the extent of the error is ascertainable by calibration, test or mathematical calculation; or

(C) By estimation on the basis of deliveries (Net Energy Output) during preceding periods of similar demand under similar conditions when the equipment was registering accurately, and for purposes of this estimation, the Parties may agree upon using data from measurements from outside of the measurement facility.

ii. In the event that the Parties cannot agree on the actual period during which the inaccurate measurements were made, the period during which the measurements are to be adjusted shall be the shorter of (i) the last one-half of the period from the last previous test of the Natural Gas metering device, or (ii) the (120) Days immediately preceding the test which found the Natural Gas metering device to be defective or inaccurate.

To the extent that the adjustment period covers a period of deliveries for which payment has already been made by GPA, GPA shall use the corrected measurements as determined in accordance with Articles 13.3(b) (i) or (ii) hereof to recompute the amount due for the period of the inaccuracy and shall subtract the previous payments by GPA for this period from such recomputed amount. If the difference is a positive number, the difference shall be paid by GPA to Project Company. If the difference is a negative number, the difference shall be paid by Project Company to GPA, or in the sole discretion of GPA, the difference may take the form of an offset to payments due to Project Company by GPA. Payment of such difference by the owing Party shall be made not later than thirty (30) Days after the owing Party receives Notice of the amount due, unless GPA elects payment via an offset.

13.4 ULSD Metering

(a) ULSD Fuel Metering Equipment

i. GPA shall be responsible at its cost for installing and maintaining primary ULSD measurement equipment at the ULSD metering station in the ULSD pipelines supplying ULSD to the Facility in accordance with Schedule 6. GPA shall read its meter(s) at that point and such readings shall be considered official meters.

ii. Project Company may install ULSD backup measurement equipment downstream of GPA's measurement equipment for ULSD. In such case, Project Company shall be responsible for installing and maintaining the ULSD backup measurement equipment.

iii. GPA's ULSD metering devices shall be inspected, tested, and calibrated by GPA at least once each three (3) years. If Project Company at any time desires a special test of any meter or the computer used in the operation of the GPA's ULSD metering devices, it will promptly notify GPA and the Parties will then co-operate to secure a prompt test. All tests of GPA's ULSD metering devices shall be made at GPA expense, except that Project Company shall bear the GPA's reasonable cost of special tests made at the Project Company's request if the inaccuracy is found to be within 1%. Following each test, GPA shall ensure that GPA's ULSD metering devices shall be adjusted as required to record centrally and accurately.

iv. Project Company's ULSD metering devices shall be inspected, tested, and calibrated by Project Company at least once each three (3) years. If GPA at any time desires a special test of any meter or the computer used in the operation of Project Company's ULSD metering devices, it will promptly notify Project Company and the parties will then co-operate to secure a prompt test. All tests of Project Company's ULSD metering devices shall be made at Project Company's expense, except that GPA shall bear Project Company's reasonable cost of special tests made at GPA's request if the inaccuracy is found to be within 1%. Following each test, Project Company shall ensure that Project Company's ULSD metering devices shall be adjusted as required to record centrally and accurately.

v. Project Company shall, or shall have other party(ies) on its behalf, install and maintain measurement equipment at the ULSD truck delivery stations with the coordination and approval of GPA. The specifications and the location for ULSD Fuel meters and the associated metering system are set forth in Schedule 12. The measurement equipment for each Fuel shall be installed next to the storage tank dedicated to the respective Fuel.

vi. The Project Company's ULSD metering devices shall be inspected tested and calibrated in accordance with the provisions of Schedule 12.

(b) Adjustment for Inaccurate ULSD Meters.

i. If, for any reason, Project Company's main ULSD meters are out of service or registering outside the specified limits, so that the quantity of ULSD consumed cannot be ascertained or computed from the reading thereof,

the ULSD consumed during the period such meters are out of service shall be determined upon the basis of the best data available, using the first of the following methods which is feasible:

(A) By using the quantity recorded by Project Company's back-up ULSD meters, if accurately registering; or

(B) By adjusting for the error, if the extent of the error is ascertainable by calibration, test or mathematical calculation.

ii. In the event that the Parties cannot agree on the actual period during which the inaccurate measurements were made, the period during which the measurements are to be adjusted shall be the shorter of (i) the last one-half of the period from the last previous test of the ULSD metering device, or (ii) the (120) Days immediately preceding the test which found the ULSD metering device to be defective or inaccurate.

To the extent that the adjustment period covers a period of deliveries for which payment has already been made by GPA, GPA shall use the corrected measurements as determined in accordance with Articles 13.4(a) (i) or (ii) hereof to recompute the amount due for the period of the inaccuracy and shall subtract the previous payments by GPA for this period from such recomputed amount. If the difference is a positive number, the difference shall be paid by GPA to Project Company. If the difference is a negative number, the difference shall be paid by Project Company to GPA, or in the sole discretion of GPA, the difference may take the form of an offset to payments due to Project Company by GPA. Payment of such difference by the owing Party shall be made not later than thirty (30) Days after the owing Party receives Notice of the amount due, unless GPA elects payment via an offset.

ARTICLE 14
BILLING AND PAYMENT

14.1 Invoices

(a) Invoices shall be prepared monthly by Project Company in accordance with this Article 14 for payment by GPA in Dollars, as specified in this Article 14.

(b) GPA and Project Company shall read directly by their representatives or via billing centers the metering devices on the first Day of each Month at 00:00 or 10:00 a.m., commencing with the first Month of the Period of Testing.

(c) Project Company shall render an itemized invoice to GPA by the tenth (10th) Day of each Month of the Term, commencing in respect of amounts due by GPA for deliveries of Net Energy Output and/or Dependable Capacity hereunder, with the first Month immediately following the Month in which the Phase 1 Commercial Operation Date occurs.

(d) Not used.

(e) Each itemized invoice for amounts due by GPA to Project Company under Article 14.1(c) for deliveries of Net Energy Output and/or Dependable Capacity hereunder in respect of any month from and after the Phase 1 Commercial

Operation Date shall show, calculated, where applicable, in accordance with Schedule 5:

i. Net Energy Output delivered to GPA during each half hour of the previous Month and the total Net Energy Output for such Month;

ii. The Energy Charge for such Net Energy Output, and the Capacity Charge for the previous Month;

iii. Supplemental Charges, if any;

iv. any adjustments or offsets pursuant to Article 13, Article 9.7, or Article 18 hereof;

v. any adjustments pursuant to Article 14.3;

vi. any adjustments pursuant to Article 7.3(c);

vii. any adjustment pursuant to Article 4.3.2(a);

viii. the total amount in Dollars that is due from GPA to Project Company with respect to such deliveries of Net Energy Output and Dependable Capacity during the preceding Month, including, for the avoidance of doubt, the full Capacity Charge for the Dependable Capacity in the event that the Dependable Capacity is unavailable, in whole or in part, due to a request by GPA in accordance with this Agreement, due to a Scheduled Outage, due to a Maintenance Outage, due to a Forced Outage, due to a condition caused by GPA or by the Grid System, or due to the unavailability of Fuel during any period during which the Facility is deemed to provide the Dependable Capacity in Article 8.

14.2 Payment

Each invoice shall be paid within thirty (30) Days of receipt thereof, with those portions of the Price to be adjusted and calculated in accordance with Schedule 5.

GPA intends to make an initial lump sum payment of approximately $50 million upon COD to reduce interest fees and payments over the contract term.

14.3 Estimates

In order that invoices may be rendered promptly after the end of each Month, it may be necessary, from time to time, to estimate certain factors involved in calculating the monthly billing. Adjustments for errors in such estimates shall be included in the invoice for the first Month following the time when the information necessary to make such corrections or adjustments becomes available.

14.4 Late Payment

If an invoice is not paid within thirty (30) Days of receipt thereof (the "**Invoice Due Date**"), interest on unpaid amounts shall accrue daily from the Invoice Due Date until the date upon which payment is made at the Bank Rate plus two percent (2%).

14.5 Disputed Amounts

In the event of any Dispute as to the Capacity Charge, Energy Charge, or the Supplemental Charges, GPA shall notify Project Company of the amount in dispute. In such event, the amounts not disputed shall be paid as described in this Article 14 and GPA shall either deposit in escrow with a commercial bank selected by GPA and reasonably acceptable to Project Company an amount equal to the disputed amounts on the date such amounts, if undisputed, would otherwise be due or furnish to Project Company an irrevocable and unconditional letter of credit issued by a commercial bank selected by GPA and reasonably acceptable to the Project Company in an amount equal to the disputed amounts. This letter of credit shall be in a form and substance reasonably satisfactory to Project Company. The Dispute will be settled in accordance with the Dispute resolution procedures set forth in Article19. The resolution of the disputed amount shall include interest at the rate specified for late payment in Article 14.4. Upon resolution, the funds in the escrow account shall be disbursed in accordance with the resolution of the matter under Article 19.

14.6 Billing Errors

Any claim regarding an error in invoices previously paid shall be made (in accordance with Article 14.5 or 14.7) within fifteen (15) Business Days from the date of discovery of such error, but in any event no later than the date six (6) Months after the date of issuance of such invoice. If such claim is not made within the six-month period referred to in the previous sentence, the original invoice and the calculations therein shall be binding upon the Parties.

14.7 Inaccurate Meters

In the event adjustments to an invoice are required as a result of corrected measurements made with respect to inaccurate meters as described in Article 13.2, the Parties shall use the method of correcting measurements described in Article 13.2 to recompute the amounts due from or to GPA for the Net Energy Output and, in the event of corrected measurements made in respect of any Dependable Capacity Test, the Dependable Capacity sold under this Agreement during the period of inaccuracy. If the total amount, as recomputed, due from a Party for the period of one inaccuracy varies from the total amount due as previously computed, and payment of the previously computed amount has been made, then, following agreement by the Parties on the amount due as a result of the recomputation, Project Company shall promptly issue an adjusted billing statement. The owing Party shall pay any amount owed as shown on such billing statement within thirty (30) Days of the issuance of the adjusted billing statement.

ARTICLE 15
INSURANCE REQUIREMENTS

15.1 Terms and Conditions

(a) All insurance policies are subject to the jurisdiction and laws of the United States.

(b) All insurance policies should be effected through insurers registered in the United States to the extent required by the Laws of Guam.

(c) Re-insurance of all policies should be in accordance with the effective instructions issued by the insurance commission or any substitute authority and

accordingly, insurers should prove that they have implemented the aforesaid instructions.

(d) Insurance is subject to cut through clause and insured have the right to claim from either insurers or reinsurers or both of them.

(e) Project Company shall not be obliged to obtain any insurance policies covering sabotage, war or terrorism risk.

15.2 Maintenance of Insurance Policies

(a) Project Company shall obtain and maintain from and after Financial Close and throughout the term of this Agreement the policies of insurance set forth in the minimum coverage amounts (or if not set forth, on terms and conditions, including sub-limits, deductibles and exclusions that are obtained by independent power generators of comparable size, technology and location) and during the periods, provided, however, that such minimum amounts may be changed from time to time with the written consent of GPA, which consent may not be unreasonably withheld or delayed. In addition to the foregoing, the Project Company may obtain any additional coverage required by the Lenders or the Laws of Guam, or deemed necessary by Project Company. Project Company shall not be in breach of its obligations hereunder if and to the extent that any particular insurance policy, or amount of coverage or any particular term of policy is not or ceases to be available on commercially reasonable terms for reasons other than any negligence or default by, or the deterioration of the financial condition of Project Company from the date of execution of this Agreement.

(b) In the event that any particular insurance policy or amount of coverage required to be maintained hereunder ceases to be available on commercially reasonable terms for reasons other than any negligence or default by, or the deterioration of the financial condition of Project Company from the date of this Agreement, Project Company shall notify GPA of such occurrence promptly upon becoming aware of it, and GPA shall have the option to procure such particular policy or amount of coverage and to require Project Company to reimburse it for the cost thereof up to an amount not exceeding the premium paid by Project Company immediately prior to such insurance becoming unavailable on commercially reasonable terms (provided that the terms of such policy and the insurers and reinsurers providing it are otherwise substantially the same as those of the policy that it replaces).

15.3 Insurance Requirements for the Construction Period

(a) Cargo transportation insurance (imports and re-exported items):

This insurance shall cover all materials, equipments, machineries, spares and other items for incorporation into the Facility against all risks of physical loss or damage while in transit by sea and\or air and/or by land conveyance and/or sending by post from the country of origin anywhere in the world to the site, or vice versa, from the time the insured items leave the warehouse or the factory and\or place of storage for shipment to the site (final destination named in the policy), plus war, strikes, riot and civil commotions in accordance with the provisions of institute cargo clause "**A**", war, strikes, and civil commotions or land transit "All Risks clause".

Coverage shall be in an amount equal to the cost, freight and all other expenses and fees.

In the alternative, Project Company may satisfy its obligations hereunder by requiring the vendor of such items to insure them in the manner specified herein, provided the vendor names Project Company and the other parties and first provides Project Company with evidence of such insurance, a copy of which shall be provided to GPA upon request.

Name of insureds include Project Company, GPA and all other concerned parties.

(b) Delay in start up following cargo transport insurance:

This insurance shall cover debt service and fixed costs incurred following delays in reaching the Required Commercial Operation Date as a direct result of physical loss or damage to the materials, equipments, machineries and other items in transit by sea and/or air and/or by motor truck to the site to the extent covered under the cargo transport insurance.

This insurance shall indicate indemnity period not less than one calendar year as from the date of the occurrence of the risk covered under the transport policy.

15.4 Insurances Required During Construction Period Plus Erection, Trial Testing and Commissioning Period Plus Debt Service and Fixed Operation and Maintenance Costs Loss Due to Delay

(a) Contractors all risks policy (C.A.R. Policy):

This insurance shall cover all permanent and temporary works at the site in the course of execution, including machinery and equipment for incorporation in the Facility, against all risks of physical loss or damage (other than nuclear risk, penalties, consequential losses, cash, vehicles, vessels and aircraft) and shall include cover for loss or damage caused by faulty design, defective workmanship and defective material. Coverage shall be not less than the probable maximum loss value of the items covered.

Coverage also shall include equipment, machinery used by the concerned parties plus removal of debris, and third party liability plus cross liability during the period of construction plus one calendar year maintenance period.

(b) Delay in start up following C.A.R. incidents:

This insurance shall cover debt service and fixed operation and maintenance costs incurred following delays in reaching the Required Commercial Operation Date as a direct result of physical loss or damage to the works to the extent that such loss or damage is covered under the C.A.R. policy.

(c) Professional indemnity policy:

This policy, which the Project Company shall have the option to obtain and maintain if it considers it necessary taking into account the financial standing of the Construction Contractor, covers any loss or damage due to negligence, error,

mistakes, faults and/or defaults or any other risks cover under P.I. policy which occurred during the period of construction or erection.

This policy shall include a sum insured equal to the said losses and/or damage.

15.5 Insurances Requirements after Construction Stage

(a) Properties insurance:

Subject to all risks policy to cover buildings, structures, fittings, equipments, machineries, appliances and/or other items.

This insurance to cover the said properties against:

ix. Fire and other allied perils plus debt service and fixed operation and maintenance costs due to fire and/or other allied perils.

x. To cover the physical loss or damage due to sudden and unforeseen cause.

xi. This policy shall include the machinery breakdown perils subject to Munich-Re specimen or similar policy wording and also to cover debt service and fixed operation and maintenance costs due to machinery breakdown.

Note: Coverage shall be not less than the probable maximum loss value of the items covered. Indemnity period for debt service and fixed operation and maintenance costs due to fire or due to machinery breakdown is not less than one calendar year as from the date of occurrence of the original risk.

(b) Workmen's compensations policy for all workers and employees in accordance with the provisions of Guam labour law.

(c) Employer's liability towards temporary workers and other employees.

(d) Motor insurance policy (comprehensive cover) to include third party liability plus the cars and all vehicles and spares and appliances.

(e) Public liability insurance policy to cover any legal liability (bodily injuries and damages to property). Such policy should be sufficient to cover, at a minimum, US$ [ ] for any one occurrence and in aggregate US$ [ ] for bodily injuries and US$ [ ] for property damages.

ARTICLE 16
LIABILITY AND INDEMNIFICATION

16.1 Limitation of Liability

Except as expressly provided in this Article 16, without prejudice to any rights to damages that either Party may have as expressly provided for in Articles 5, 9 and 17, neither Party shall be liable to the other Party in contract, tort, warranty, strict liability or any other legal theory for any indirect, consequential, incidental, punitive or exemplary damages or for loss of revenue or loss of profits. In respect of a breach of the provisions of this Agreement, neither Party shall have any liability to the other Party save as expressly stated in this

Agreement; provided, however, that this provision is not intended to constitute a waiver of any rights of one Party against the other with regard to matters unrelated to this Agreement or to any activity not contemplated by this Agreement.

16.2 Indemnification

(a) GPA

Subject to Article 16.5, GPA shall indemnify Project Company and Project Company's officers, directors, shareholders and employees against, and hold Project Company and Project Company's officers, directors, shareholders and employees harmless from, at all times after the date hereof, any and all Losses, and any and all actions, claims and demands in respect of such Losses, incurred, suffered, sustained, or required to be paid, directly or indirectly, by, or sought to be imposed upon, Project Company or Project Company's officers, directors, shareholders or employees for personal injury or death to persons or damage to property arising out of the negligent or intentional acts or omissions of GPA in connection with this Agreement.

(b) The Project Company

Subject to Article 16.5, Project Company shall indemnify GPA and GPA's officers, directors, shareholders and employees against, and hold GPA and GPA's officers, directors, shareholders and employees harmless from, at all times after the date hereof, any and all Losses, and any and all actions, claims and demands in respect of such Losses, incurred, suffered, sustained, or required to be paid, directly or indirectly, by, or sought to be imposed upon, GPA or GPA's officers, directors, shareholders or employees for personal injury or death to persons or damage to property arising out of the negligent or wilful default of Project Company in connection with this Agreement.

(c) Joint Negligence

Subject to Article 16.5, in the event that any Loss results from the joint or concurrent negligent or intentional acts or omissions of the Parties, each Party shall be liable under this indemnification in proportion to its relative degree of fault.

16.3 Indemnification for Fines and Penalties

Any fines or other penalties incurred by Project Company for non-compliance with the applicable Laws of Guam or the Government Authorizations shall not be reimbursed by GPA but shall be the sole responsibility of Project Company, except to the extent that such non-compliance is caused by the negligence or intentional acts or omissions of GPA.

16.4 Notice of Proceedings

Each Party shall promptly notify the other Party of any Loss, claim, action, demand or proceeding in respect of which it is or may be entitled to indemnification under Article 16.2. Such Notice shall be given as soon as reasonably practicable after the relevant Party becomes aware of the Loss, claim, action, demand or proceeding. Failure to give such Notice in a timely fashion shall not affect the indemnified Party's rights to indemnification except to the extent that the indemnifying Party is materially prejudiced thereby.

16.5 Limitation on Indemnification

(a) Each Party shall be solely liable, and shall not be entitled to assert any claim for indemnification under this Agreement for any Loss that would otherwise be the subject of indemnification under this Agreement until all Losses of such Party arising during the current Contract Year exceed the equivalent of two hundred thousand Dollars (US$ 200,000) in the aggregate in which case only the amount of Loss greater than two hundred thousand Dollars (US$ 200,000) shall be subject to indemnification. For purposes of this Article 16.5, a Loss (or claim for indemnification) shall be deemed to arise in the Contract Year during which the event giving rise to the Loss (or claim for indemnification) occurred or, in the case where the event is continuing in more than one Contract Year, in the Contract Year during which the event ends, provided that a Party shall not be obliged to refrain from making a claim under this Article 16.5 (where it is otherwise entitled to do so) at the end of a given year ("**Year End**") by reason of the fact that the event in question ("**Relevant Event**") is still continuing, and provided further that in the event that such Party does make such a claim at the Year End it shall continue to be able to claim in relation to all remaining Losses arising from the Relevant Event regardless of when they occur.

(b) Neither Party shall be entitled to the indemnity under Article 16.2 if and to the extent that a Party has received payment in respect of a Loss or proceeding under the indemnities contained in the Lease Agreement or any other document comprising the Security Package in respect of the relevant act or omission.

16.6 Defence of Claims

(a) The indemnifying Party shall be entitled, at its option, to assume and control the defence of such claim, action, suit or proceeding at its expense with counsel of its selection and the indemnified Party shall provide it with a power of attorney if required for this purpose, provided it gives prompt Notice of its intention to do so to the indemnified Party and reimburses the indemnified Party for the reasonable costs and expenses incurred by the indemnified Party prior to the assumption by the indemnifying Party of such defence.

(b) Unless and until the indemnifying Party acknowledges in writing its obligation to indemnify the indemnified Party and assumes control of the defence of a claim, suit, action or proceeding in accordance with Article 16.6(a), the indemnified Party shall have the right, but not the obligation, to contest, defend and litigate, with counsel of its own selection, any claim, action, suit or proceeding by any third party alleged or asserted against the indemnified Party in respect of, resulting from, related to or arising out of any matter for which it is entitled to be indemnified hereunder, and the reasonable costs thereof shall be subject to the indemnification obligations of the indemnifying Party hereunder.

(c) Upon assumption by the indemnifying Party of the control of the defence of a claim, suit, action or proceeding, the indemnifying Party shall reimburse the indemnified Party for the reasonable costs and expenses of the indemnified Party in the defence of the claim, suit, action or proceeding prior to the indemnifying Party's acknowledgement of the indemnification and assumption of the defence.

(d) Following the acknowledgement of the indemnification and the assumption of the defence by the indemnifying Party, the indemnified party shall have the right to employ its own counsel and such counsel may participate in such claim, suit, action or proceeding, but the fees and expenses of such counsel shall be at the expense of such indemnified Party, when and as incurred, unless (i) the employment of counsel by such indemnified Party has been authorised in writing by the indemnifying Party, (ii) the indemnified Party shall have reasonably concluded that there may be a conflict of interest between the indemnifying Party and the indemnified Party in the conduct of the defence of such action, (iii) the indemnifying Party shall not in fact have employed independent counsel reasonably satisfactory to the indemnified party to assume the defence of such action and shall have been so notified by the indemnified Party, or (iv) the indemnified Party shall have reasonably concluded and specifically notified the indemnifying Party either that there may be specific defences available to it that are different from or additional to those available to the indemnifying Party or that such claim, action, suit or proceeding involves or could have a material adverse effect upon it beyond the scope of this Agreement. If clauses (ii), (iii) or (iv) of the preceding sentence shall be applicable, then counsel for the indemnified Party shall have the right to direct the defence of such claim, action, suit or proceeding on behalf of the indemnified Party and the reasonable fees and disbursements of such counsel shall constitute legal or other expenses hereunder, subject to the indemnification obligations of the indemnifying Party hereunder.

ARTICLE 17
FORCE MAJEURE

17.1 Definition

For the purposes of this Agreement, a "**Force Majeure**" means a cause or event (i) that is beyond the reasonable control of the affected Party and was not due to the fault or negligence of the affected Party and that prevents such Party's performance of its obligations under or pursuant to this Agreement, and (ii) which the affected Party is unable to prevent, overcome or remedy by the exercise of diligence and reasonable care, or avoid by the exercise of reasonable foresight and mitigation [, it being understood and agreed that reasonable care includes the expenditure of sums of money ("**Mitigating Costs**") to protect the Facility from a casualty event, which sums are reasonable in light of the likelihood of such event, the probable effect of such event if it should occur, and the likely efficacy of the protection measures].

"**Force Majeure**" shall include the following events and circumstances, but only to the extent that each satisfies the above requirements:

(a) floods, hurricanes, tornadoes, typhoons, cyclones, earthquakes and other natural calamities;

(b) fires or explosions that could not have been prevented by acting in accordance with industry standards or Prudent Utility Practices, as applicable;

(c) war (declared or undeclared), riots, insurrection, rebellion, civil disturbance, acts of the public enemy, acts of terrorism and sabotage, blockades, embargoes or sanctions;

(d) strikes which are widespread within the Territory of Guam, regional and industry-wide labor disputes unless affecting only or caused by Project Company or its Contractors (or their subcontractors of any tier) or their employees;

(e) any Change in Law:

(f) the unavailability of Fuel supply or Fuel transportation as a result of Force Majeure.

Force Majeure shall expressly not include the following conditions, except and to the extent that they result from a Force Majeure:

(a) the absence of sufficient financial means to perform obligations or the failure to make payments in accordance with this Agreement;

(b) weather conditions that could reasonably be expected to occur by an experienced contractor or electric generator in Guam other than extreme or unusually severe weather conditions that constitute a Force Majeure event in accordance with clause above;

(c) shortages, unavailability, late delivery, or changes with respect to materials, spare parts, supplies, consumables or components of equipment for the Project;

(d) price fluctuations with respect to materials, spare parts, supplies, consumables or components of equipment for the Project;

(e) late delivery of materials, supplies or components of equipment;

(f) economic hardship;

(g) shortages of manpower;

(h) the delay, default or failure to perform by a contractor or subcontractor;

(i) machinery or equipment breakdown;

(j) customs procedures

(k) flaws in the Final Technical Specifications prepared by Contractor which require Contractor to re-design or re-engineer any portion of the Project or otherwise change or modify the Work.

(l) normal wear and tear or random flaws in materials and equipment or breakdowns in equipment.

No event, whether or not it constitutes "Force Majeure" will excuse GPA from the obligation to:

(a) make any payment when due and payable under this Agreement, provided that if the occurrence or effects of a Force Majeure affects the operation of all or a portion of the Facility, GPA shall continue, during the continuance of such Force Majeure or its effects, to pay the Capacity Charge for each MW of Dependable Capacity, after deducting from the Capacity Charge an amount determined by multiplying the Capacity Charge by a fraction, the numerator of which is the

capacity that is unavailable due to the Force Majeure, and the denominator of which is the Dependable Capacity.

(b) fulfill payment obligations under this Agreement including payment of the full Capacity Charge for the Dependable Capacity.

In the event that the Facility and associated energy is unavailable, in whole or in part, due to:

i. the unavailability of Fuel supply or, subsequent to the transfer of the Electrical Interconnection Facilities to GPA, the unavailability of the Electrical Interconnection Facilities or electric transmission or distribution service sufficient to export the entire output of the Facility; or

ii. a condition caused by GPA or the Grid System,

the Facility, to the extent it is unavailable due to the foregoing reasons, shall be deemed available and providing the Dependable Capacity for the purposes of calculating liquidated damages under Article 9.

17.2 Notification Obligations

(a) The Party affected by a Force Majeure shall give Notice to the other Party of any event constituting a Force Majeure as soon as reasonably practicable. Any Notice shall include full particulars of the event constituting a Force Majeure, of its effects on the Party claiming relief and the remedial measures proposed, including estimated cost and time to restore the Project, if appropriate. The Party affected by a Force Majeure shall coordinate with the other Party and give the other Party regular reports on the progress of those remedial measures and such other information as the other Party may reasonably request.

(b) The Party affected by a Force Majeure shall give Notice to the other Party of (i) the cessation of the relevant event constituting a Force Majeure, and (ii) the cessation of the effects of such event constituting a Force Majeure on the enjoyment by such Party of its rights or the performance by it of its obligations under this Agreement, as soon as reasonably practicable after becoming aware of each of (i) and (ii) above.

17.3 Duty to Mitigate

The affected Party shall be responsible to use all reasonable efforts to mitigate the effects and costs of a Force Majeure.

17.4 Term Extension

If, during any period, the Dependable Capacity is not available due to the occurrence or effects of a Force Majeure and this Agreement is not terminated earlier than the original Term, the Term of this Agreement and the Lease Agreement shall be extended by the number of Days that the Dependable Capacity was not available due to the occurrence or effects of such Force Majeure.

17.5 Delay Caused by Force Majeure

Except as otherwise set forth below, neither Party shall be responsible or liable for or deemed in breach hereof because of any failure or delay in complying with its obligations (other than an obligation to make a payment) under or pursuant to this Agreement due to one or more events of Force Majeure or its or their effects or by any combination thereof, and the periods allowed or dates required (including the Required Commercial Operation Dates) for the performance by Parties of such obligation(s) shall be extended on a day-for-day basis to account for such event(s), effects or combination thereof; provided that no relief shall be granted to the Party claiming Force Majeure pursuant to this Article 17 to the extent that such failure or delay would have nevertheless been experienced by that Party had such Force Majeure not occurred.

17.6 Adjustments for Change in Law

(a) In the event of a Change in Law which is of the type described in the Change in Law definition and has an impact on the Project that is equal or greater to [$500,000] for a Contract Year , GPA shall pay to Project Company (without double recovery) a Supplemental Charge under this Agreement in such amount as is necessary to compensate Project Company for, and make Project Company whole with respect to any such additional costs and/or adverse affect on the expected financial benefit suffered as a result of such Change in Law.

(b) In the event of a Change in Law that has a positive impact on the Project Company that is equal to or greater than [US$500,000] for a Contract Year , Project Company shall adjust the Capacity Charge under this Agreement in such amount as is necessary to return the benefit of such increase to GPA.

ARTICLE 18
TRANSFER OF OWNERSHIP

18.1 Facility Transfer

(a) On the Transfer Date, Project Company shall transfer to GPA, free from any lien or encumbrance and without the payment of compensation, all right, title and interest in and to the Facility including all fixtures, fittings, plant and equipment (including all test equipment, special tools, as-built drawings, software, documents, reports, analyses, all relevant files, plant procedures and forms as reasonably required and necessary for GPA to effectively operate the Facility after the transfer) and all improvements comprising the Facility (the "Facility Transfer"), provided that there is no default in payment obligations by GPA that has not been cured.

(b) Six (6) months prior to the Transfer Date, GPA and Project Company shall meet and agree on the inventories involved and the mechanics of the Facility Transfer but Project Company shall not be liable for any discrepencies between such inventories and the actual fixtures, fittings, plant and equipment transferred, provided that following agreement on inventories Project Company shall exercise the same care regarding the fixtures, fittings, plant and equipment and all improvements therein as it did prior to agreeing to the same and provided further that GPA shall be entitled to provide a security unit within the Site.

(c) [ ] shall be responsible for all costs and expenses (including legal fees and taxes or duties) incurred in connection with the Facility Transfer and shall at its own cost obtain or effect all Government Authorizations and other approvals, licenses, registrations and filings and take such other action as may be necessary for the Facility Transfer as contemplated in this Article 18, and reimburse [ ] on demand for all such costs and expenses incurred by [ ] in respect thereof.

18.2 Testing Prior to End of Term and Facility Transfer

(a) Unless this ECA is terminated early, during the last year of the Term, the Project Company shall perform the tests described in Schedule 4 ("End of Term Tests") and the final pre-Facility Transfer overhaul described in Schedule 1 (the "Final Major Overhaul"). In the event that the End of Term Test results demonstrate that the Facility requires repair and/or replacement of equipment or parts, the Project Company shall carry out such corrective action as is required by Schedule 1.

(b) If the Facility does not satisfy the requirements of Schedule 1, including the performance requirements set forth in Schedule 1, the Project Company shall immediately take such actions as will cause the Facility to comply with the requirements of Schedule 1. If the Project Company fails to cause the Facility to comply with the requirements of Schedule 1 within thirty (90) Days prior to the expiration of the Term, GPA (or its nominee) may take such measures as may be required for the Facility to comply with the requirements of Schedule 1 at the sole expense of the Project Company. In the event that Project Company does not make timely payments for such expenses, GPA shall have the right to draw such amounts from the Transfer Security and/or set off such amounts under Article 14.1(e)(iv).

18.3 Transfer Overhaul

Three (3) years prior to the expiration of the Term, the Project Company shall deliver to GPA a plan that is consistent with Prudent Utility Practices and reasonably acceptable to GPA setting out the anticipated costs and activities associated with the Final Major Overhaul and the Facility Transfer. The Final Major Overhaul shall occur no earlier than 18 months and no later than 6 months from the expiration of the Term. In the event that GPA, acting reasonably, does not agree with the costs and activities anticipated by the Project Company in such transfer plan and the Parties cannot agree on the costs and activities, the Dispute shall be resolved in accordance with ARTICLE 19, provided, however, that the Project Company's obligations under the transfer plan shall always be limited to the scope set out in Schedule 1. The plan shall also describe the reserves to be maintained by the Project Company to cover these anticipated costs and activities. The Project Company shall maintain adequate reserves to complete the Facility Transfer obligations required by Schedule 1.

18.4 Transfer Security

On or prior to the end of the twenty-first (21st) Contract Year, the Project Company shall deliver to GPA a security deposit in the amount of US$15,000,000 (the "Transfer Security"). The security deposit shall be issued in one of the forms set out in Article 6 as security for performance of the Project Company's obligations under this ARTICLE 18. The deposit shall

remain valid for one (1) year subsequent to the date of Facility Transfer. In the event that Project Company has not delivered the security deposit in favor of GPA by the end of the twenty-first (21st) Contract Year, GPA shall have the right to withhold payments to Project Company (including payment amounts owed pursuant to Article 14) up to the Transfer Security amount.

ARTICLE 19
CHOICE OF LAW AND RESOLUTION OF DISPUTES

19.1 Governing Law

This Agreement and the rights and obligations hereunder shall be interpreted, construed and governed by the laws of Guam and all applicable laws of the United States of America.

19.2 Initiation of Dispute Resolution

(a) In the event that a Dispute arises, the Parties shall attempt in good faith to settle such Dispute by mutual discussions within thirty (30) Days after the date that the disputing Party gives Notice of the Dispute to the other Party which may include referring the Dispute to the Joint Coordinating Committee for a specified time period, subject to mutual agreement of the Parties.

(b) In the event that the Dispute is not resolved in accordance with Article 19.2(a), either Party may refer the Dispute to the chief executive officer or chief operating officer of Project Company and GPA for further consideration. In the event that such individuals are unable to reach agreement within fifteen (15) Days, or such longer period as they may agree, then either Party may commence arbitration of the Dispute in accordance with Article 19.3

19.3 Arbitration

(a) Any Dispute arising out of or in connection with this Agreement and not resolved following the procedures described in Article 19.2 shall be finally settled by arbitration under the ICC Rules by three (3) arbitrators appointed in accordance with the ICC Rules.

(b) Any arbitration shall be conducted in English, and unless otherwise agreed by the Parties, the number of arbitrators shall be three (3).

(c) The place of arbitration shall be Guam.

(d) Unless otherwise provided in this Agreement, during the conduct of Dispute resolution the Parties shall continue to perform their respective obligations under this Agreement.

(e) The arbitration tribunal may consolidate an arbitration arising out of or relating to this Agreement with any arbitration arising out of or relating to the Lease Agreement if the subject matter of the Disputes arises out of or relates to essentially the same facts or transactions. Such consolidated arbitration shall be

determined by the arbitration tribunal appointed for the arbitration proceeding that was commenced first in time.

19.4 Consent to Jurisdiction

Each Party hereby consents to the jurisdiction of the courts of Guam for any action filed by the other Party to enforce a judgment entered for the purpose of recognising any award or decision of any arbitrator(s) or expert(s) who were duly appointed under this Agreement to resolve any Dispute between the Parties. With respect to any such proceedings for the enforcement of any such award against the assets of a Party:

(a) GPA appoints [ ] the [ ] of GPA, whose address is presently Gloria B. Nelson Public Service Building 688 Route 15 Fadian, Mangilao, Guam, to receive for and on its behalf service of process in such jurisdiction in any such enforcement proceeding; and

(b) The Project Company appoints its [ ], whose address is presently at [ ], to receive for and on its behalf service of process in such jurisdiction in any such enforcement proceeding.

ARTICLE 20
NO LIABILITY FOR REVIEW

No review, non-objection or approval by GPA of any agreement, document, instrument, drawing, specifications or design proposed by Project Company shall relieve Project Company from any liability that it would otherwise have had for its negligence or wilful misconduct (i) in the preparation of such agreement, document, instrument, drawing, specification or design or (ii) the failure to comply with the applicable Laws of Guam with respect thereto.

ARTICLE 21
SHARE TRANSFER AND DISPOSAL OF ASSETS

21.1 Shares Certificate Legend Requirement

With respect to the transfer of the registered ownership of any Shares, Project Company (i) shall include appropriate legends on all share certificates evidencing Shares of Project Company to put prospective purchasers of such Shares on notice of the restrictions in the following provisions and, (ii) to the extent permitted by the Laws, shall not register or give effect to any purported transfer of Shares that is not in compliance with such restrictions or do not bear such legend.

21.2 Transfer Restriction

Prior to the second anniversary of the Phase 2 Commercial Operation Date, none of the Initial Shareholders shall (i) transfer any Shares owned by them or (ii) merge into or consolidate with any other individual, corporation, company, voluntary association, partnership, joint venture, trust, or (iii) dispose of assets of Project Company at any time, except for:

(a) a transfer required by any Laws or by the operation of the Laws or by order of a court, tribunal, or Governmental Authority with appropriate jurisdiction; or

(b) a transfer resulting from the enforcement of a pledge or security interest in or over any Shares in accordance with the Security Package; or

(c) a transfer of Shares in accordance with the Lenders' Direct Agreement; or

(d) a transfer to which GPA has given its prior written approval.

ARTICLE 22
NOTICES

Except as otherwise expressly provided in this Agreement, all notices, communications, or other documents (together "**Notices**") to be given or made by one Party to the other Party pursuant to this Agreement shall be in English and in writing, shall be addressed for the attention of the person indicated below, and shall be delivered by hand or sent by reputable international express courier by facsimile, or registered mail. Any Notice given by facsimile shall be confirmed by sending a copy of the same by personal delivery or by registered mail, but the failure to so confirm shall not void or invalidate the original Notice if it is in fact received by the Party to which it is addressed. The addresses for service of the Parties and their respective facsimile numbers are:

[.....]

or such other addresses and facsimile numbers as either Party may have notified to the other Party in accordance with this Article 22.

All Notices shall be deemed delivered (a) when presented personally, (b) when transmitted by facsimile to the receiving Party's facsimile number specified above, (c) one (1) Day after being delivered to a courier for express delivery, addressed to the receiving Party, at the address indicated above (or such other address as such Party may have specified by written Notice), or (d) five (5) Days after being sent by registered mail addressed to the receiving Party, at the address indicated above (or such other address as the receiving Party may have specified by written Notice). Any Notice given by facsimile shall be confirmed in writing delivered personally or sent by registered mail, but the failure to so confirm shall not void or invalidate the original Notice if it is in fact received by the Party to which it is addressed.

ARTICLE 23
MISCELLANEOUS PROVISIONS

23.1 Amendment

This Agreement cannot be amended except by prior written agreement between the Parties.

23.2 Headings

The headings contained in this Agreement are used solely for convenience and do not constitute a part of this Agreement nor shall such headings be used in any manner to aid in the construction of this Agreement.

23.3 Third Parties

This Agreement is intended solely for the benefit of the Parties hereto. Nothing in this Agreement shall be construed to create any duty or any liability to or any right of suit or action whatsoever, to any person not a Party to this Agreement.

23.4 No Implied Waiver

The failure or delay of either Party to enforce at any time any of the provisions of this Agreement, or to require at any time performance by the other Party of any provision hereof, shall neither be construed to be a waiver of such provisions nor affect the validity of this Agreement or any part hereof or the right of such Party thereafter to enforce each and every such provision.

23.5 Relationship of the Parties

This Agreement shall not be interpreted or construed to create an association, joint venture, partnership or agency between the Parties or to impose any partnership obligation or liability upon either Party. Neither Party shall have any right, power or authority to enter into any agreement or undertaking for, or act on behalf of, or to act as or be an agent or representative of, or to otherwise bind, the other Party. Nothing in this Agreement shall be construed as creating any relationship between the Parties other than that of independent sale and purchase of capacity and electricity generated at the Facility. Except as otherwise set forth herein, the Parties do not intend to create any rights, or grant any remedies to, any third party beneficiary of this Agreement. Therefore, Project Company shall be solely responsible for the payment of salaries, wages and mandatory and fringe benefits of its employees, which will not have any labour relationship with GPA.

23.6 Rights of Inspection

Project Company shall promptly furnish to GPA such information as GPA may from time to time reasonably request. Subject to Article 7.5, Project Company shall permit representatives of GPA on reasonable notice and during reasonable hours to visit the Facility, such visit to be at the cost of GPA.

23.7 Periodic Reports

(a) Each Party shall, as soon as available but in any event within one hundred twenty (120) Days after the end of each fiscal year, furnish to the other Party: (a) two (2) copies of its complete financial statements for such fiscal year (which are in agreement with its books of accounts and are prepared in accordance with accounting principles which are generally accepted in Guam and consistently applied), together with an audited report thereon; (b) a copy of any management letter or other communication sent by the auditors to the Party or to its management in relation to the Party's financial, accounting and other systems, management and accounts; and (c) a report by the auditors certifying that, based on its financial statements, the Party was in compliance with its financial obligations as of the end of the relevant fiscal year or, as the case may be, detailing any non-compliance. In addition, each Party shall authorise its auditors (whose fees and expenses shall be for the account of the Party) to communicate directly with the other Party at any time regarding the Party's accounts and operations and shall furnish to the other Party a copy of such Authorization.

(b) Each Party shall, as soon as available but in any event within sixty (60) Days after the end of each six (6) Month period of each fiscal year, furnish to the other Party: (i) two (2) copies of balance sheets of such Party, as of the close of that period, and statements of sources and uses of income and retained earnings and changes in the Party's capital accounts and financial position, for the period and

for the portion of the fiscal year ending with that period, in each case setting forth in comparative form the figures for the corresponding period for the preceding fiscal year, all in reasonable detail and in accordance with the generally accepted accounting principles in Guam consistently applied and certified as complete and correct, subject to changes resulting from year-end adjustments, by the chief accounting officer of the Party; and (ii) a report on any factors materially and adversely affecting or that might materially and adversely affect the Project or the Party's business and operations or its financial condition.

23.8 Survival

Articles [1, 2, 6.3, 6.4, 16, 19, 23, and 23] shall survive the cancellation, expiration or termination of this Agreement.

23.9 Language

The language of this Agreement shall be English. All documents, Notices, waivers and all other communication written or otherwise between the Parties in connection with this Agreement shall be in English.

23.10 Entirety

This Agreement and Schedules attached hereto [and the LLA] and any scedules or annexes thereto, taken together, are intended by the Parties as the final expression of their agreement and are intended also as a complete and exclusive statement of the terms of their agreement with respect to the subject matter of this Agreement and the LLA. All prior written or oral understandings, offers or other communications of every kind pertaining to the sale or purchase of capacity and energy hereunder to GPA by Project Company or to Project Company by GPA or pertaining to the connection of the Facility to the Grid System are hereby abrogated and withdrawn.

23.11 Assignment

This Agreement may not be assigned by either Party other than by mutual agreement between the Parties in writing. Notwithstanding the foregoing, for the purpose of financing or refinancing the Facility, GPA agrees that Project Company may assign to the Lenders its rights and interest or create security over its rights and interest under or pursuant to (i) this Agreement, (ii) the Facility, (iii) the movable property and intellectual property of Project Company and (iv) the revenues or any of the rights or assets of Project Company. The Parties acknowledge and agree that provisions, which shall be agreed with the Lenders, will be included in the Lenders' Direct Agreement which will provide, inter alia, for the Lenders' security interest and cure and step-in rights in and under this Agreement.

23.12 Successors and Assigns

This Agreement shall be binding upon, and inure to the benefit of, the Parties hereto and their respective legal successors and assigns permitted in accordance with Article 23.11.

23.13 Confidentiality

Each of the Parties shall hold in confidence the agreements relating to the Project and all documents and other information, whether technical or commercial, which is of a confidential nature supplied to it by or on behalf of the other Party relating to the design,

construction, insurance, operation, maintenance, management and financing of the Project and shall not publish, disclose or use the same for its own purposes other than as may be required to perform its obligations under this Agreement or as may be required by law.

23.14 Counterparts

This Agreement may be executed in more than one counterpart, each of which shall be deemed to be an original and all of which when taken together shall be deemed to constitute one and the same instrument.

23.15 Severability

If one or more provisions contained in this Agreement are held or found to be invalid, illegal, or unenforceable in any respect, the provision(s) shall be given effect to the extent permitted by law and the invalidity, illegality, or unenforceability of any provisions shall not affect the validity of the remaining provisions of this Agreement.

GENERATION
Cabras 1 & 2

Revised: 12/20/2018

- Assistant Plant Superintendent
  - Plant Elect./Inst. Maint. Supervisor
    - Plant Electrician Leader
      - Plant Electrician II
      - Plant Electrician II
    - Plant Instrument Technician Leader
      - Plant Instrument Technician II
  - Plant Maintenance Supervisor
    - Plant Maintenance Mechanic Leader
      - Plant Maintenance Mechanic II
      - Plant Maintenance Welder III
      - Plant Maintenance Mechanic II
  - Plant Shift Supervisor
    - Control Operator
    - Control Operator
    - Plant Operator III
    - Plant Operator III
    - Plant Operator II
    - Plant Water Technician II
  - Plant Shift Supervisor
    - Control Operator
    - Control Operator
    - Plant Operator III
    - Plant Operator III
    - Plant Operator III
    - Plant Operator II
    - Plant Water Technician II
  - Plant Shift Supervisor
    - Control Operator
    - Plant Operator III
    - Plant Operator III
    - Plant Water Technician II
  - Plant Operator/Maint Supervisor
    - Control Operator
    - Plant Operator III
    - Plant Operator III
    - Plant Operator II
    - Plant Operator I
    - Plant Water Technician II
  - Plant Operator/Maint Supervisor
    - Plant Operator III
    - Plant Operator III

Aggreko
- Plant Electrician II

PITI 7
- Plant Electrician II
- Plant Operator II

PSCC
- Control Operator