



**Specifications
for
Virgin Islands Water & Power Authority**

**East End Substation
Restoration & Expansion Project
Phase 2 (13.2kV GIS)
St. Thomas, USVI**

ISSUE FOR BID

Prepared by:



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DIVISION 01
GENERAL REQUIREMENTS

SECTION 00100 – SPECIAL PROVISIONS

1. SCOPE OF SECTION

- A. The special provisions of this division are intended as modifications or supplements to Information for Bidders, General Conditions, or Technical Specifications and the intent of any provisions of this division shall govern.
- B. Materials and construction pertaining to the installation of the power source and control systems shall be in accordance with NEC and NESC Standards.

2. ORDER OF WORK

The Contractor will carefully coordinate his work with the Virgin Islands Water and Power Authority. The Contractor shall submit a detailed time schedule. This schedule shall be incorporated into the construction schedule to be submitted to the Engineer.

3. COOPERATION WITH OTHERS

The Contractor will coordinate with Virgin Islands Water and Power Authority or others who may be engaged in authorized work prior to final completion of the project.

4. PRE-CONSTRUCTION CONFERENCE

Upon award of Contract, the Owner will schedule a pre-construction conference. This conference must be attended by the Engineer, Resident Project Representative, the Contractor, Subcontractors, Material Suppliers, the Water and Power Authority's representative and other agencies, which may be affected. The purpose is to review the project scope, determine the project schedule, and discuss problems that may be encountered.

5. SECURITY

The Contractor is responsible for maintaining security at the work site.

6. CONTRACTOR'S OFFICE

The Contractor shall maintain a temporary field office near the work for his own use during the period of construction at which readily accessible copies of all contract documents shall be kept. The office shall be located where it will not interfere with the progress of the work. In charge of this office, there shall be a competent superintendent of the Contractor as specified under "Supervision of Work" in the AGREEMENT.

7. TEMPORARY CONTROLS

- A. Dust Control: The Contractor shall provide for adequate protection against raising objectionable dust clouds caused by moving construction equipment, high winds, or any other cause. All piles of dirt used for construction must be covered with tarpaulins or plastic sheets. The Contractor shall provide for adequate protection of the work area to prevent nuisance and damage to adjacent property and vehicular traffic from abrasive blasting debris, and the spray there from and

shall be solely responsible for any damage resulting there from.

- B. The Contractor shall provide for adequate protection against polluting public or private lands, lakes, ponds, rivers, streams, creeks, etc., by disposal of surplus material in the form of solids, liquids or gases, or from any other cause.
- C. The Contractor shall evaluate and assess the impact of any adverse effects on the natural environment which may result from construction operations and shall operate to minimize pollution of air, ground or surface waters and vegetation, and afford the neighboring community the maximum protection during and upon completion of the construction project.
- D. The Contractor shall take sufficient precautions to prevent pollution of streams, lakes, reservoirs, and ground water with fuels, oils, bitumens, calcium chloride and other harmful materials. He shall conduct and schedule his operations so as to avoid or otherwise prevent pollution or siltation of streams, lakes, ground water and reservoirs, and to avoid interference with movement of migratory fish.
- E. All chemicals used during construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, reactant, or other classification, must show approval of either EPA or USDA. Use of all such chemicals and disposal of residues shall be in strict conformance with instructions.
- F. Paint Splatter Control: The Contractor shall take precautions necessary to prevent paint splatter from falling on adjacent buildings and vehicular traffic and shall be solely responsible for any damage resulting there from.

8. PERSONAL PROTECTIVE EQUIPMENT POLICY

The East End Substation site is an active energized location. All personnel shall wear the proper personal protective equipment (PPE) to work in an energized high voltage electrical substation with voltage levels of 34.5KV and 15KV to include hard hats and safety equipment at the work site at all times. The Engineer is authorized to halt the work if this requirement is not met.

9. GENERAL QUALITY OF MATERIAL AND WORKMANSHIP

Unless otherwise specifically stated in the Contract Documents, the Contractor shall provide and pay for materials, labor, tools, equipment, water, light, power, transportation, supervision, and temporary construction of any nature, and other services and facilities of any nature, whatsoever necessary, to execute, complete and deliver the work within the specified time. Material and equipment shall be new and of a quality equal to modifications which have been in successful regular operation under comparable conditions. This requirement does not apply to minor details or to thoroughly

demonstrated improvements in design or in materials of construction. Construction work shall be executed in conformity with the standard practice of the trade. Should there be more than one specification applicable to a particular aspect of design, construction, or procedure; the more stringent requirement shall prevail.

10. MATERIALS AND EQUIPMENT FURNISHED BY OWNER

Materials and equipment specified to be furnished by the Owner shall be received and installed by the Contractor. Furnishing of material and equipment by the Owner will be considered conclusive evidence to their acceptability for the purpose intended. If the Contractor discovers defects in material or equipment furnished by the Owner, he shall notify the Engineer. After such discovery, the Contractor shall not proceed with work involving Owner-furnished materials and equipment unless authorized by VIWAPA. Unless otherwise noted or specifically stated, materials and equipment furnished by the Owner, which are not of local occurrence are considered to be FOB marine terminal or truck terminal nearest to the site of the work. The Contractor shall unload, transport, store and protect such material and equipment from damage. After receipt by the Contractor at the point of delivery, Owner-furnished material and equipment shall form part of the Work for purposes of the Contract, including risk of loss, as if it had been supplied and stored by the Contractor himself.

11. HURRICANE / INCLEMENT WEATHER PREPAREDNESS PLAN

- A. Where the construction period is between July and October, within 30 days of the date of Notice to Proceed, the Contractor shall submit to the Engineer a Hurricane Preparedness Plan. The plan should submit to the outline the necessary measures which the contractor proposes to perform at no additional cost to the Owner in case of a hurricane warning.
- B. In the event of inclement weather, or whenever the Engineer shall direct, the Contractor will, and will cause Subcontractors to, protect carefully the work and materials against damage or injury from the weather. If in the opinion of the Engineer, any portion of work or materials should have been damaged or injured by reason of failure on the part of the Contractor or any Subcontractors to so protect the work, such work and materials shall be removed and placed at the expense of the Contractor.

12. TRAFFIC CONTROL

The following standards and specifications are considered to be part of the Traffic Control Plan:

- Section 635 of the Standard Specifications, FP-96
- Section 635 of the Supplemental Specifications
- Manual on Uniform Traffic Control Devices, current edition.

- All signs shall be faced with sheeting conforming to Type II-A or Type III. See section 718, FP-96.

In addition to the above standards and specifications, the specific provisions for this project are also set forth as follows:

A. MAINTENANCE OF TRAFFIC

1. Two-way traffic, one lane each way, will be maintained on weekdays during the peak hours on two-way streets. Work that will interfere with two-way traffic will be conducted on weekends or during off-peak periods. During weekends and off-peak periods, alternating one-way traffic on one lane may be maintained by the use of flagmen to control and maintain traffic. Two-way traffic must be restored by the end of each workday.
2. Existing traffic patterns will be maintained to the maximum extent practicable during construction work.

B. GENERAL REQUIREMENTS

1. Traffic Control Devices shall be furnished by the Contractor and shall be maintained in compliance with the Federal Manual of Uniform Traffic Control Devices (MUTCD), current edition, and latest revision at time of contract. The Contractor shall be responsible for maintaining signs at all times or as directed by the Engineer. Signs, permanent or temporary, that are not current to the traffic pattern will be removed or covered with plywood.
2. Suspension of Work. If the Contractor fails to comply with the provision for traffic control as set forth in the plans or with provisions of the MUTCD, the Engineer shall suspend work until the Contractor complies with the necessary requirements.
3. Prior Notice. Ten (10) days prior to implementation of any maintenance of Traffic Phase, the Contractor will provide The Public Works Department, through the Project Engineer, a description of the type of work to be done. During construction, the Contractor shall inform the Engineer of any changes in traffic patterns within the work zone. Prior to any restriction of traffic, the Contractor and The Public Works Department will issue a news release describing the work and the traffic patterns that will be employed.
4. All work shall be prosecuted in a manner to permit unimpeded traffic flow in conformance with the Traffic Control Plan whenever possible. The interruption of traffic shall not be permitted except as identified unless specifically allowed by the Engineer. Work operation shall be scheduled to minimize disruption at peak traffic periods.
5. Access to the site will be by normal traffic patterns. The Contractor shall identify proposed haul routes and prepare traffic control plans of those routes.

6. Pedestrians. Facilities for pedestrian crossing shall be maintained at all times. Facilities for the safe stopping, loading, and unloading of buses shall be maintained at all times.
7. Driveway Access. Access to driveways and roadways must be maintained at all times, except as provided in the TCP.
8. Variations from the Traffic Control Plan. If the Contractor feels he can improve on the Traffic Control Plan, he is encouraged to submit his proposal in writing for consideration and approval by the Engineer.
9. Contractor's Traffic Control Plan. Prior to commencing work, the Contractor shall submit for the Engineer's approval his proposed method of controlling traffic. Any suggestions to improve on traffic control shall be submitted for the Engineer's approval at this time. Prior coordination with the Dept. of Public Works is required to arrive at a mutually agreed upon TCP.
10. The employment or presence of traffic flagmen, special officers, or police shall in no way relieve the Contractor of any responsibility or liability, which is his under the terms of the contract.
11. All work conducted within rights-of-way must be prearranged through the Department of Public Safety. A Road Closure Permit must be obtained. All traffic pattern drawings; safety signs and flagmen are the responsibility of the Contractor. Contractor is to make all necessary arrangements with the Department of Public Safety. It may be required that work be performed on Saturdays, Sundays or Holidays to accommodate traffic conditions.

END OF SECTION 00100

SECTION 01000 - GENERAL SPECIFICATIONS

1. DEFINITIONS

Wherever the words defined in this section or pronouns used in their stead occur in the Contract Documents, they shall have the meanings herein given.

1.1 As Directed, as required, etc.

Wherever in the Contract Documents, or on the Drawings, the words "as directed," "as ordered," "as requested," "as required," "as permitted," or words of like import are used, it shall be understood that the direction, order, request, requirement, or permission of the Engineer is intended. Similarly, the words "approved," "acceptable," "suitable," "satisfactory," and words of like import shall mean approved by, acceptable to, suitable to, or satisfactory to the Engineer.

1.2 Elevation

The figures given on the Drawings or in the other Contract Documents after the word "elevation" or abbreviation of it shall mean the distance in feet above the datum adopted by the Engineer.

1.3 Rock

The word "rock", wherever used as the name of an excavated material of material to be excavated, shall mean only boulders and pieces of concrete or masonry exceeding 1 cu. yd. in volume, or solid ledge rock which, in the opinion of the Engineer, requires, for its removal drilling, hammering, blasting, wedging, sledging, barring, or breaking up with a power-operated tool. No soft or disintegrated rock which can be removed with a hand pick or power-operated excavator or shovel, or loose, shaken, or previously blasted rock or broken stone in rock fillings or elsewhere, and no rock exterior to the maximum limits of measurement allowed, which may fall into the excavation, will be measured or allowed as "rock".

1.4 Earth

The word "earth", wherever used as the name of an excavated material or material to be excavated, shall mean all kinds of material other than rock as above defined.

2. ABBREVIATIONS

Where any of the following abbreviations are used in the Contract Documents, they shall have the meaning set forth opposite each.

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AISC	American Institute of Steel Construction
ANS	American National Standard
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
125-lb. ANS	American National Standard for Cast-iron
250-lb. ANS	Pipe Flanges and Flanged Fittings, Designation B16.1-1975, for the appropriate class
AWG	American or Brown and Sharpe Wire Gage
NEC	National Electric Code
NESC	National Electrical Safety Code
NPT	National Pipe Thread
NSI	National Sanitation Foundation
OS&Y	Outside screw and yoke
Stl. WG	U S Steel Wire, Washburn and Moen, American Steel and Wire or Roebling Gage
USS Gage	United States Standard Gage

3. HANDLING AND DISTRIBUTION

The Contractor shall handle, haul, and distribute all materials and all surplus materials from the different portions of the work, as necessary or required; shall provide suitable and adequate storage space for materials and equipment during the progress of the Work, and be responsible for the protection, loss of or damage to materials and equipment furnished by him, until the final completion and acceptance of the Work.

Storage and demurrage charges by transportation companies and vendors shall be borne

by the Contractor.

4. MATERIALS - SAMPLES - INSPECTION

Unless otherwise expressly provided on the Drawings or in any of the other Contract Documents, only new materials and equipment shall be incorporated in the Work. All materials and equipment furnished by the Contractor to be incorporated in the Work shall be subject to the inspection of the Engineer. No material shall be processed or fabricated for the Work or delivered to the Work site without prior concurrence of the Engineer.

As soon as possible after execution of the AGREEMENT, the Contractor shall submit to the Engineer the names and addresses of the manufacturers and suppliers of all materials and equipment he proposes to incorporate into the Work. When shop and working drawings are required as specified below, the Contractor shall submit prior to the submission of such drawings, data in sufficient detail to enable the Engineer to determine whether the manufacturer and/or the supplier have the ability to furnish a product meeting the Specifications. As requested, the contractor shall also submit data relating to the materials and equipment he proposes to incorporate into the Work in sufficient detail to enable the Engineer to identify and evaluate the particular product and to determine whether it conforms to the Contract requirements. Such data shall be submitted in a manner similar to that specified for submission of shop and working drawings. Facilities and labor for the storage, handling, and inspection of all materials and equipment shall be furnished by the Contractor. Defective materials and equipment shall be removed immediately from work site. If the Engineer so requires, either prior to or after commencement of the Work, the Contractor shall submit samples of materials for such special tests, as the Engineer deems necessary to demonstrate that they conform to the Specifications. Such samples shall be furnished, taken, stored, packed, and shipped by the Contractor as directed. Except as otherwise expressly specified, the Owner shall make arrangements for, and pay for, the tests.

All samples shall be packed so as to reach their destination in good condition, and shall be labeled to indicate the material represented, the name of the building or work and location for which the material is intended, and the name of the Contractor submitting the sample. To ensure consideration of samples, the Contractor shall notify the Engineer, by letter that the samples have been shipped and shall properly describe the samples in the letter. The letter of notification shall be sent separate from and should not be enclosed with the samples (properly described in the letter).

The Contractor shall submit data and samples, or place his orders, sufficiently early to permit consideration, inspection and testing before the materials and equipment are needed for incorporation in the Work. The consequences of the Contractor's failure to do so shall be his sole responsibility.

In order to demonstrate the proficiency of workmen, or to facilitate the choice among several textures, types, finishes, surfaces, etc., the Contractor shall provide such samples of workmanship of wall, floor, finish, etc., as may be required.

When required, the Contractor shall furnish to the Engineer sworn copies of

manufacturer's shop or mill tests (or reports from independent testing laboratories) relative to materials, equipment performance ratings, and concrete data.

After review of the samples, data, etc., the materials and equipment used on the Work shall in all respects conform therewith.

5. CONTRACTOR'S SHOP AND WORKING DRAWINGS

The Contractor shall submit shop and working drawings of concrete reinforcement, piping layout, materials fabricated especially for the Contract, and materials and equipment for which such drawings are specifically requested.

Such drawings shall show the principal dimensions, weight, structural and operating features, space required, clearances, type and/or brand of finish or shop coat, grease fittings, etc., depending on the subject of the drawing. When it is customary to do so, when the dimensions are of particular importance, or when so specified, the drawings shall be certified by the manufacturer or fabricator as correct for the Contract. As part of the shop drawing submittal, submit a list with the names, identification numbers, and quantities of spare parts, instruments, and equipment to be provided by the Contractor.

When so specified, or if considered by the Engineer to be acceptable, manufacturer's specifications, catalog data, descriptive matter, illustrations, etc., may be submitted in place of shop and working drawings. In such a case, the requirements shall be as specified for shop and working drawings, insofar as applicable.

The Contractor shall be responsible for the prompt and timely submittal of all shop and working drawings so that there shall be no delay to the Work due to the absence of such drawings. Prior to the submittal of any shop drawings, the Contractor shall submit a schedule of proposed shop drawing transmittals. The schedule shall identify the subject matter of each transmittal, the corresponding specification section number and the proposed date of submission. During the progress of the Work, the schedule shall be revised and resubmitted as necessary.

No material or equipment shall be purchased or fabricated especially for the Contract until the required shop and working drawings have been submitted as hereinabove provided and reviewed for conformance to the Contract requirements. All such materials and equipment and the work involved in their installation or incorporation into the Work shall then be as shown in and represented by said drawings.

Until the necessary review has been made, the Contractor shall not proceed with any portion of the Work or the design of any details, which are dependent upon the design, or details of work, materials, equipment or other features for which review is required.

All shop and working drawings shall be submitted to the Engineer by/or through the Contractor, who shall be responsible for obtaining the shop and working drawings. All shop and working drawings shall be prepared on standard size, 24-inch by 36-inch or 11-inch by 17-inch sheets, except those, which are made by changing existing standard shop or working drawings. All drawings shall be clearly marked with the names of the Owner, contractor, and building, equipment, or structure to which the drawing applies, and shall

be suitably numbered. Each shipment of drawings shall be accompanied by a Transmittal Form furnished by the Contractor giving a list of the drawing numbers and the names mentioned above.

Only drawings, which have been checked and corrected by the fabricator, should be submitted to the Contractor by his subcontractors and vendors. Prior to submitting drawings to the Engineer, the Contractor shall check thoroughly all such drawings to be satisfied that the subject matter thereof conforms to the Drawings and Specifications in all respects. All drawings that are correct shall be marked with the date, checker's name, and indication of the Contractor's approval, and then shall be submitted to the Engineer; other drawings shall be returned for correction.

If a shop drawing shows any deviation from the Contract requirements, the Contractor shall make specific mention of the deviations in the Transmittal Form furnished by the Contractor and provide a description of the deviations in a letter attached to the submittal.

The review of shop and working drawings hereunder will be general only, and nothing contained in this GENERAL SPECIFICATION shall relieve, diminish or alter in any respect the responsibilities of the Contractor under the Contract Documents and, in particular, the specific responsibility of the Contractor for details of design and dimensions necessary for proper fitting and construction of the work as required by the Contract and for achieving the result and performance specified there under.

The marked-up reproducible of the shop and working drawings or one marked-up copy or catalog cuts will be returned to the Contractor. The Contractor shall furnish additional copies of such drawings or catalog cuts when so required.

6. OCCUPYING PRIVATE LAND

The Contractor shall not (except after written consent from the proper parties) enter or occupy with men, tools, materials, or equipment, the land outside the rights-of-way or property of the Owner. A copy of the written consent shall be given to the Engineer.

7. INTERFERENCE WITH AND PROTECTION OF STREETS

The Contractor shall not close or obstruct any portion of a street, road, or private way without obtaining permits therefore from the proper authorities. If any street, road or private way shall be rendered unsafe by the contractor's operations, he shall make such repairs or provide such temporary ways or guards as shall be acceptable to the proper authorities.

Streets, roads, private ways, and walkways not closed shall be maintained passable and safe by the contractor, who shall assume and have full responsibility for the adequacy and safety of provisions made therefore.

8. STORAGE OF MATERIALS AND EQUIPMENT

Materials and equipment to be incorporated in the work shall be stored so as not to injure any part of the Work or existing facilities and to ensure free access at all times to all parts of the Work and to all utility installations in the vicinity of the Work. Materials and equipment shall be kept neatly piled and compactly stored in such locations as will cause a minimum of inconvenience.

9. SAFETY

The Contractor shall take all necessary precautions and provide all necessary safeguards to prevent personal injury and property damage. The Contractor shall provide protection for all persons including but not limited to his employees and employees of other contractors or subcontractors; members of the public; and employees, agents, and representatives of the Owner, the Engineer, and regulatory agencies that may be on or about the Work. The Contractor shall provide protection for all public and private property including but not limited to structures, pipes, and utilities, above and below ground.

The Contractor shall provide and maintain all necessary safety equipment such as fences, barriers, signs, lights, walkways, guards and fire prevention and fire-fighting equipment and shall take such other action as is required to fulfill his obligations under this subsection.

The Contractor shall comply with all applicable Federal, State and local laws, ordinances, rules and regulations and lawful orders of all authorities having jurisdiction over the safety of persons and protection of property.

The contractor shall designate a responsible member of his organization at the site whose duty shall be the prevention of accidents. This responsible person shall have the authority to take immediate action to correct unsafe precautions and programs.

10. SANITARY REGULATIONS

The Contractor shall provide adequate sanitary facilities for the use of those employed on the Work. Such facilities shall be made available when the first employees arrive on the site of the Work, shall be properly secluded from public observation, and shall be constructed and maintained during the progress of the Work in suitable numbers and at such locations and in such a manner as may be required. The Contractor shall maintain the sanitary facilities in a satisfactory and sanitary condition at all times and shall enforce their use. He shall rigorously prohibit the committing of nuisances on the site of the Work, on the lands of the Owner, or on adjacent property.

11. DIMENSIONS OF EXISTING STRUCTURES

Where the dimensions and locations of existing structures are of importance in the installation or connection of any part of the Work, the Contractor shall verify such dimensions and locations in the field before the fabrication of any material or equipment which is dependent on the correctness of such information.

12. WORK TO CONFORM

During its progress and on its completion, the Work shall conform truly to the lines, levels, and grades indicated on the Drawings or given by the Engineer and shall be built in a thoroughly substantial and workmanlike manner, in strict accordance with the Drawings, Specifications, and other Contract Documents and the directions given from time to time by the Engineer.

13. COMPUTATION OF QUANTITIES

For estimating quantities in which the computation of areas by geometric methods would be comparatively laborious, it is agreed that the planimeter shall be considered an instrument of precision adapted to the measurement of such areas.

It is further agreed that the computation of the volume of prismsoids shall be by the method of average end areas.

14. PLANNING AND PROGRESS SCHEDULES

Before starting the Work and from time to time during its progress, as the Engineer may request, the Contractor shall submit to the Engineer a written description of the methods he plans to use in doing the Work and the various steps he intends to take.

Within 15 days after the date of formal execution of AGREEMENT, the Contractor shall prepare and submit to the Engineer (a) a written schedule fixing the dates on which additional drawings, if any, will be needed by the Contractor and (b) a written schedule fixing the respective dates for the start and completion of various parts of the Work. Each such schedule shall be subject to review from time to time during the progress of the Work.

15. PRECAUTIONS DURING ADVERSE WEATHER

During adverse weather and against the possibility thereof, the Contractor shall take all necessary precautions so that the Work may be properly done and satisfactory in all respects. When required, protection shall be provided by use of tarpaulins, wood and building-paper shelters, or other suitable means.

16. ELECTRICAL ENERGY

The Contractor shall make all necessary arrangements for electrical energy for power and light necessary for the proper completion of the work and during its entire progress. The Contractor shall provide and pay for all temporary wiring, switches, connections, and meters. Source of power will be determined by VIWAPA.

The Contractor shall provide sufficient electric lighting so that all work may be done in a workmanlike manner when there is not sufficient daylight.

17. PROTECTION AGAINST ELECTROLYSIS

Where dissimilar metals are used in conjunction with each other, suitable insulation shall be provided between adjoining surfaces so as to eliminate direct contact and any resultant electrolysis. The Insulation shall be bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators or washers, or other acceptable materials.

18. RECORD CONTRACT DRAWINGS

Contractor shall keep one (1) record copy of all Contract Documents, reference documents, and all technical submittals at the Site in good order and annotated to show all changes made during the construction process. Record drawings shall be up-dated and kept current on a daily basis by the Contractor. The record drawings will be reviewed by the Engineer prior to approval of the Contractor's pay request. At the completion of the Project and before final payment is made, Contractor shall furnish the Engineer with redline documents reflecting all approved changes herein described. Changes to the drawings shall be drawn in a neat and workmanlike manner. Show horizontal distances from permanent objects and depth to each bend (applies only to buried objects). Include depth of ducts and distance from edge of road as often as there are changes in duct route. All existing utilities encountered must be shown with depth, distance ties and detail of the crossing. Accurate and approved as built drawings will be submitted prior to final payment (retainage) on the contract.

END OF SECTION

SECTION 01005 - MISCELLANEOUS REQUIREMENTS

1. GENERAL

The contractor shall conform to all miscellaneous requirements as herein specified.

2. INTERFERENCE WITH EXISTING WORKS

The Contractor shall at all times conduct his operations so as to interfere as little as possible with existing works. The Contractor shall develop a program, in cooperation with the Engineer and interested officials, which shall provide for the construction and putting into service of the new works in the most orderly manner possible. This program shall be adhered to except as deviations there from are expressly permitted. All work of connecting with existing ducts or manholes shall be planned to interfere with the operation of the existing facilities for the shortest possible time when the demands on the facilities best permit such interference, even though it may be necessary to work outside of normal working hours to meet these requirements. Before starting work which will interfere with the operation of existing facilities, the Contractor shall perform all possible preparatory work and shall see that all tools, materials, and equipment are made ready and at hand. The Contractor shall make such minor modifications in the work relating to existing structures as may be necessary, without additional compensation.

The Contractor shall have no claim for additional compensation by reason of delay or inconvenience in adapting his operations to meet the above requirements.

END OF SECTION

SECTION 01010 – SUMMARY OF WORK

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.02 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Project consists of the installation of a 13.2kV Gas Insulated switchgear to be housed in an existing GIS Building (Building was constructed under Phase 1) to service the East End Substation.

1. Project Location: East End Substation, Parcel B 2-A, Estate Nazareth, Red Hook Quarter, St. Thomas, USVI
2. Owner: Virgin Islands Water & Power Authority V.I.W.A.P.A.

- B. The Scope of work is for a new, complete 13.2kV Gas Insulated Switchgear (GIS) to be housed in an existing GIS Building as shown in the contract drawings and specifications and as summarized below:

- Furnish & install a new 13.2kV Gas Insulated Switchgear (GIS) consisting of an incoming main and four feeder breakers.
- Provide factory acceptance testing of the new 13.2kV GIS
- Furnish & install exhaust plenum through the exist GIS building
- Provide Startup, testing & commissioning of the new 13.2kV GIS
- Furnish & install an elevated platform for the new 13.2kV GIS. The platform shall be similar to the 34.5kV GIS platform that is being constructed under phase 1. The platform shall be a “delegated design”. The GIS platform shall be designed by a licensed professional structural engineer retained by the GIS vendor. The GIS vendor shall shall provide signed& sealed shop drawings for review & approval
- Furnish & install 15kV cables as follows:
 - 3 sets each of 3-1/C #750 kcmil, 15kV cable, in 3 existing 6” PVC/RGS conduits from existing power transformer T-D1 to incoming main breaker D-110
 - 1 set of 3 – 1/C #750 kcmil, 15kV cable, in 1 – existing 6” PVC conduit from Feeder breaker D-RR to the existing Ridge Road riser pole located across the street. Conduit riser on pole shall be new.
 - 1 set of 3 – 1/C #750 kcmil, 15kV cable, in 1 – existing 6” PVC conduit from Feeder breaker D-F9 to the existing feeder 9D riser pole located inside the substation fenced area.. Conduit riser on pole shall be new.
 - 1 set of 3 – 1/C #750 kcmil, 15kV cable, in 1 – existing 6” PVC conduit from Feeder breaker D-F7 to the existing feeder 7D riser pole located near manhole #4A. Conduit riser on pole shall be new.
- Test 15kV cables

- Furnish & install two 13.2kV relay panels (RP5 and RP6) to be located in the existing newly constructed control building. Bolt relay panels to the floor slab.
- Furnish & install relays, meters, lockouts, remote breaker control switches, DPAC, test switches, test blocks, fuses, terminal blocks, etc.
- Furnish & install all protection & SCADA cables in existing raceways between the existing GIS building and the control building and in the existing cable tray within the control building
- Provide Testing & Commissioning of the new 13.2kV relays & meters
- Furnish & install 120 volt AC power in existing raceways to the GIS and the two relay panels
- Furnish & install lights under the 13.2kV GIS platform

1.04 CONTRACTOR USE OF PREMISES

- A. General: During the construction period the Contractor shall have limited use of the premises and site for construction operations. Limits will be defined by VIWAPA.

END OF SECTION

SECTION 01039 – COORDINATION & MEETINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Coordination and project conditions.
- B. Preconstruction meeting.
- C. Site mobilization meeting.
- D. Progress meetings.

1.2 RELATED SECTIONS

Not Used.

1.3 COORDINATION AND PROJECT CONDITIONS

- A. Coordinate scheduling, submittals, and Work of the various sections of the Specifications to ensure an efficient and orderly sequence of construction elements.
- B. Verify all existing utility locations.

1.4 PRECONSTRUCTION MEETING

- A. Engineer will schedule a meeting after Notice of Award.
- B. Attendance Required: Owner, Engineer and Contractor, and Superintendent.
- C. Agenda: (Engineer will prepare agenda.)
 - 1. Submission of list of testing agency and other parties providing services on the project.
 - 2. Procedures and processing of field decisions, submittals, and substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 - 3. Procedures for layout of the project, establishing controls, limits of right-of-way and easements.
 - 4. Scheduling.
 - 5. Safety.
- D. Engineer shall record minutes and distribute copies to participants and those affected by decisions made.

1.5 SITE MOBILIZATION MEETING

- A. Engineer will schedule a meeting at the Project site prior to Construction start-up.
- B. Attendance Required: Engineer, Contractor's Superintendent, and major Subcontractors.
- C. Agenda: (Engineer will prepare agenda.)
 - 1. Use of site by Owner and Contractor.
 - 2. Owner's requirements.
 - 3. Construction facilities provided by Contractor.
 - 4. Temporary utilities provided by Contractor.
 - 5. Security and housekeeping procedures.
 - 6. Schedules.
 - 7. Application for payment procedures.
 - 8. Procedures for testing.
 - 9. Procedures for maintaining record documents.

1.6 PROGRESS MEETINGS

- A. Schedule and administer meetings throughout progress of the Work at bi-weekly intervals or intervals agreed to by Owner/Engineer/Contractor.
- B. Engineer will make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings.
- C. Attendance Required: Job superintendent, major Subcontractors and suppliers, Engineer, as appropriate to agenda topics for each meeting.
- D. Agenda: (Contractor will prepare agenda.)
 - 5. Review minutes of previous meetings.
 - 6. Review of Work progress.
 - 7. Field observations, problems, and decisions.
 - 8. Identification of problems which impede planned progress.
 - 9. Review of submittals schedule and status of submittals.
 - 10. Review of off-site fabrication and delivery schedules.
 - 11. Maintenance of progress schedule.
 - 12. Corrective measures to regain projected schedules.
 - 13. Planned progress during succeeding work period.
 - 14. Coordination of projected progress.
 - 15. Maintenance of quality and work standards.
 - 16. Effect of proposed changes on progress schedule and coordination.
 - 17. Other business relating to Work.
- E. Contractor shall record minutes and distribute copies to participants and those affected by decisions made.

END OF SECTION

SECTION 01400 – QUALITY CONTROL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This section includes administrative and procedural requirements for quality control services.
- B. Quality control services include inspections, tests, and related actions, including reports performed by Contractor, by independent agencies, and by governing authorities. They do not include contract enforcement activities performed by Project Engineer.
- C. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with Contract Document requirements.
- D. Requirements of this Section relate to customized fabrication and installation procedures, not production of standard products.
 - 1. Specific quality control requirements for individual construction activities are specified in the sections that specify those activities. Requirements in those sections may also cover production of standard products.
 - 2. Specified inspections, tests, and related actions do not limit Contractor's quality control procedures that facilitate compliance with contract document requirements.
 - 3. Requirements for Contractor to provide quality control services required by Project Engineer, VIWAPA, or authorities having jurisdiction are not limited by provisions of this section.

1.03 RESPONSIBILITIES

- A. Contractor Responsibilities: Unless otherwise indicated as the responsibility of another identified entity, Contractor shall provide inspections, tests, and other quality control services specified elsewhere in the contract documents and required by authorities having jurisdiction. Costs for these services are included in the contract sum.
 - 1. Where individual Sections specifically indicate that certain inspections, tests, and other quality control services are the Contractor's responsibility, the Contractor shall employ and pay a qualified independent testing agency to perform quality control services. Costs for these services are included in the contract sum.
- B. Retesting: The Contractor is responsible for retesting where results of inspections, tests, or other quality control services prove unsatisfactory and indicate noncompliance with contract document requirements, regardless of whether the original test was Contractor's responsibility.

1. The cost of retesting construction, revised or replaced by the Contractor, is the Contractor's responsibility where required tests performed on original construction indicated noncompliance with contract document requirements.
- C. Associated Services: Cooperate with agencies performing required inspections, tests, and similar services, and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include, but are not limited to, the following:
 1. Provide access to the Work.
 2. Furnish incidental labor and facilities necessary to facilitate inspections and tests.
 3. Take adequate quantities of representative samples of materials that require testing or assist the agency in taking samples.
 4. Provide facilities for storage and curing of test samples.
 5. Deliver samples to testing laboratories.
 6. Provide the agency with a preliminary design mix proposed for use for materials mixes that require control by the testing agency.
 7. Provide security and protection of samples and test equipment at the project site.
- D. Coordination: Coordinate the sequence of activities to accommodate required services with a minimum of delay. Coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.
 1. The Contractor is responsible for scheduling times for inspections, tests, taking samples, and similar activities.

1.04 SUBMITTALS

- A. The Contractor shall submit a certified written report, of each inspection, test, or similar service to the Project Engineer.
 1. Report Data: Written reports of each inspection, test, or similar service include, but are not limited to, the following:
 - a. Date of issue.
 - b. Project title and number.
 - c. Name, address, and telephone number of testing agency.
 - d. Dates and locations of samples and tests or inspections.
 - e. Names of individuals making the inspection or test.
 - f. Designation of the Work and test method.
 - g. Identification of product and specification section.
 - h. Complete inspection or test data.
 - i. Test results and an interpretation of test results.
 - j. Ambient conditions at the time of sample taking and testing.
 - k. Comments or professional opinion on whether inspected or tested Work complies with contract document requirements.
 - l. Name and signature of laboratory inspector.
 - m. Recommendations on retesting.

1.05 QUALITY ASSURANCE

- A. Qualifications for Service Agencies: Engage inspection and testing service agencies that specialize in the types of inspections and tests to be performed.

PART 2 PRODUCTS

Not Applicable

PART 3 EXECUTION

3.01 REPAIR AND PROTECTION

- A. Protect construction exposed by or for quality control service activities, and protect repaired construction.
- B. Repair and protection is Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing, or similar services.

END OF SECTION

SECTION 01600 – MATERIALS & EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This section includes administrative and procedural requirements governing the Contractor's selection of products for use in the Project.

1.03 DEFINITIONS

- A. Definitions used in this Article are not intended to change the meaning of other terms used in the Contract documents, such as "specialties," "systems," "structure," "finishes," "accessories," and similar terms. Such terms are self-explanatory and have well-recognized meanings in the construction industry.
 - 1. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - a. "Named Products" are items identified by the manufacturer's product name, including make or model number or other designation, shown or listed in the manufacturer's published product literature, that is current as of the date of the contract documents.
 - b. "Foreign Products," as distinguished from "domestic products," are items substantially manufactured (50 percent or more of value) outside the United States and its possessions. Products produced or supplied by entities substantially owned (more than 50 percent) by persons who are not citizens of, nor living within, the United States and its possessions are also considered to be foreign products.
 - 2. "Materials" are products substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.
 - 3. "Equipment" is a product with operational parts, whether motorized or manually operated, that requires service connections, such as wiring or piping.

1.04 QUALITY ASSURANCE

- A. Source Limitations: To the fullest extent possible, provide products of the same kind from a single source.
 - 1. When specified products are available only from sources that do not, or cannot, produce a quantity adequate to complete project requirements in a timely manner, consult with the Project Engineer to determine the most important product qualities before proceeding. Qualities may include attributes, such as visual appearance, strength, durability, or compatibility. When a determination has been made, select products from sources producing products that possess these qualities, to the fullest extent possible.

- B. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products that will be exposed to view in occupied spaces or on the exterior.
 - 1. Labels: Locate required product labels and stamps on concealed surfaces or, where required for observation after installation, on accessible surfaces that are not conspicuous.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, and handle products according to the manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft.
 - 1. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to assure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to the site in an undamaged condition in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 4. Inspect products upon delivery to ensure compliance with the contract documents and to ensure that products are undamaged and properly protected.
 - 5. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.
 - 6. Store heavy materials away from the project structure in a manner that will not endanger the supporting construction.
 - 7. Store products subject to damage by the elements above ground, under cover in a weathertight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.

PART 2 PRODUCTS

2.01 PRODUCT SELECTION

- A. General Product Requirements: Provide products that comply with the contract documents, that are undamaged and, unless otherwise indicated, new at the time of installation.
 - 1. Provide products complete with accessories, trim, finish, safety guards, and other devices and details needed for a complete installation and the intended use and effect.
 - 2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.
- B. Product Selection Procedures: The contract documents and governing regulations govern product selection. Procedures governing product selection include the following:
 - 1. Nonproprietary Specifications: When specifications list products or manufacturers that are available and may be incorporated in the Work, but do not restrict the Contractor to use of these products only, the Contractor may propose any available product that complies with Contract requirements. Comply with contract document provisions concerning "substitutions" to obtain approval for use of an unnamed product.

2. Descriptive Specification Requirements: Where specifications describe a product or assembly, listing exact characteristics required, with or without use of a brand or trade name, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.
3. Performance Specification Requirements: Where specifications require compliance with performance requirements, provide products that comply with these requirements and are recommended by the manufacturer for the application indicated.
 - a. Manufacturer's recommendations may be contained in published product literature or by the manufacturer's certification of performance.
4. Compliance with Standards, Codes, and Regulations: Where specifications only require compliance with an imposed code, standard, or regulation, select a product that complies with the standards, codes, or regulations specified.
5. Visual Matching: Where specifications require matching an established sample, the Engineer's decision will be final on whether a proposed product matches satisfactorily.
 - a. Where no product available within the specified category matches satisfactorily and complies with other specified requirements, comply with provisions of the contract documents concerning "substitutions" for selection of a matching product in another product category.
6. Visual Selection: Where specified product requirements include the phrase "... as selected from manufacturer's standard colors, patterns, textures ..." or a similar phrase, select a product and manufacturer that complies with other specified requirements. The Engineer will select the color, pattern, and texture from the product line selected.

PART 3 EXECUTION

3.01 INSTALLATION OF PRODUCTS

- A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other Work.
 1. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of substantial completion.

END OF SECTION

SECTION 01620 – TRANSPORTATION & HANDLING

1. GENERAL

The Contractor shall provide transportation of all equipment, materials and products furnished under these Contract Documents to the site of the work, In addition, the Contractor shall provide preparation for shipment and storage, unloading, handling and re-handling, short-term storage, extended storage, storage facilities, maintenance and protection during storage, preparation for installation, and all other work and incidental items necessary or convenient to the Contractor for the satisfactory prosecution and completion of the work.

2. HANDLING

- A. All equipment, materials, and products shall be carefully handled to prevent damage or excessive deflections during unloading or transportation. All equipment, materials, and products damaged during transportation or handling shall be repaired or replaced by the Contractor at no additional cost to VIWAPA prior to being incorporated into the work.
- B. Lifting and handling drawings and instructions furnished by the manufacturer or supplier shall be strictly followed. Eyebolts or lifting lugs furnished on the equipment shall be used in handling the equipment. Shafts and operating mechanisms shall not be used as lifting points. Spreader bars or lifting beams shall be used when the distances between lifting points exceeds that permitted by standard industry practice. Slings and chains shall be padded as required to prevent damage to protective coatings and finishes.
- C. Under no circumstances shall equipment or products such as pipe, structural steel, castings, reinforcement, lumber, piles, poles, etc., be thrown rolled off of trucks onto the ground.
- D. Items such as nonmetallic pipe and nonmetallic conduit, shall be handled using nonmetallic slings or straps.

END OF SECTION

SECTION 01630 – STORAGE & PROTECTION

1. GENERAL

- A. Equipment shall be received, inspected, unloaded, handled, stored, maintained, and protected by the Contractor in a suitable location on or off site, if necessary, until such time as installation is required.
- B. Storage and protection of Contractor-furnished equipment shall be strict conformance with the requirements of VIWAPA.

2. STORAGE

- A. The Contractor shall be responsible for providing satisfactory storage facilities, which are acceptable to the Engineer. In the event that satisfactory facilities cannot be provided on site, satisfactory warehouse, acceptable to the Engineer, will be provided by the Contractor for such time until the equipment, materials, and products can be accommodated at the site.
- B. Equipment, materials, and products which are stored in a satisfactory warehouse acceptable to the Engineer will be eligible for progress payments as though they had been delivered to the job site.
- C. The Contractor shall be responsible for the maintenance and protection of all equipment, materials, and products placed in storage and shall bear all costs of storage, preparation for transportation, transportation, rehandling, and preparation for installation.
- D. Equipment and products stored outdoors shall be supported above the ground on suitable wooden blocks or braces arranged to prevent excessive deflection or bending between supports. Items such as pipe, structural steel, and sheet construction products shall be stored with one end elevated to facilitate drainage.
- E. Unless otherwise permitted in writing by the Engineer, building products and materials such as cement, grout, plaster, gypsum-board, particle-board, finish lumber, wiring, etc., shall be stored indoors in a dry location. Building products such as rough lumber, plywood, concrete block, and structural tile may be stored outdoors under a properly secured waterproof covering.
- F. Tarpaulins and other coverings shall be supported above the stored equipment or materials on wooden strips to provide ventilation under the cover and minimize condensation. Tarpaulins and covers shall be arranged to prevent ponding of water.
- G. Sensitive equipment shall be stored in weather protected environments consistent with manufacturer recommendations and specifically approved by VIWAPA. Where temporary power is required for heaters, intermittent battery charging, etc., Contractor shall supply the required temporary electrical components. VIWAPA shall direct power source connection points and shall provide said energy without charge for the energy used

END OF SECTION

SECTION 01700 – CONTRACT CLOSEOUT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout including, but not limited to, the following:
 - 1. Inspection procedures.
 - 2. Project record document submittal.
 - 3. Operation and maintenance manual submittal.
 - 4. Submittal of warranties.
- B. Closeout requirements for specific construction activities are included in the appropriate sections in Divisions 1 through 26.

1.03 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, complete the following. List exceptions in the request.
 - 1. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the Work claimed as substantially complete.
 - a. Include supporting documentation for completion as indicated in these contract documents and a statement showing an accounting of changes to the contract sum.
 - b. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.
 - 2. Advise VIWAPA, of pending insurance changeover requirements.
 - 3. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications, and similar documents.
 - 4. Obtain and submit releases enabling VIWAPA, unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 5. Submit record drawings, maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 - 6. Deliver tools, spare parts, extra stock, and similar items.
 - 7. Make final changeover of permanent locks and transmit keys to VIWAPA. Advise VIWAPA's personnel of changeover in security provisions.
 - 8. Complete startup testing of systems and instruction of VIWAPA's operation and maintenance personnel. Discontinue and remove temporary facilities from the site, along with mockups, construction tools, and similar elements.

9. Complete final cleanup requirements to include touchup painting.
10. Touch up and otherwise repair and restore marred, exposed finishes.

- B. Inspection Procedures: On receipt of a request for inspection, Project Engineer will either proceed with inspection or advise the Contractor of unfilled requirements. Engineer will advise the Contractor of construction that must be completed or corrected before the certificate will be issued.
1. Project Engineer will repeat inspection when requested and assured that the Work is substantially complete.
 2. Results of the completed inspection will form the basis of requirements for final acceptance.

1.04 FINAL ACCEPTANCE

- A. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following. List exceptions in the request.
1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include insurance certificates for products and completed operations where required.
 2. Submit an updated final statement, accounting for final additional changes to the contract sum.
 3. Submit a certified copy of Project Engineer's list of items to be completed or corrected, endorsed and dated by the Engineer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance and shall be endorsed and dated by Project Engineer.
 4. Submit consent of surety to final payment.
 5. Submit a final liquidated damages settlement statement.
 6. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
- B. Re-inspection Procedure: Project Engineer will re-inspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except for items whose completion is delayed under circumstances acceptable to Engineer.
1. Upon completion of re-inspection, Project Engineer will prepare a certificate of final acceptance. If the Work is incomplete, Project Engineer will advise the Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.
 2. If necessary, re-inspection will be repeated.

1.05 RECORD DOCUMENT SUBMITTALS

- A. General: Do not use record documents for construction purposes. Protect record documents from deterioration and loss in a secure, fire-resistant location. Provide access to record documents for the Project Engineer's reference during normal working hours.

- B. Record Drawings: Maintain a clean, undamaged set of blue or black line white prints of contract drawings and shop drawings. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark which drawing is most capable of showing conditions fully and accurately. Where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Show particular attention to concealed elements that would be difficult to measure and record at a later date.
- C. Record Specifications: Maintain two (2) complete copies of the Project Manual, including addenda. Include with the Project Manuals one (1) copy each of other written construction documents, such as Change Orders and modifications issued in printed form during construction. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the Specifications and modifications.
- D. Record Product Data: Maintain two (2) copies of each product data submittal. Note related change orders and markup of record drawings and Specifications. Mark these documents to show significant variations in actual Work performed in comparison with information submitted.
- E. Record Sample Submitted: Immediately prior to Substantial Completion, the Contractor shall meet with Project Engineer and VIWAPA's personnel at the Project Site to determine which Samples are to be transmitted to VIWAPA, for record purposes. Comply with VIWAPA's instructions regarding delivery to VIWAPA's sample storage area.
- F. Miscellaneous Record Submittals: Refer to other specification Sections for requirements of miscellaneous record keeping and submittals in connection with actual performance of the Work. Immediately prior to the date or dates of Substantial Completion, complete miscellaneous records and place in good order. Identify miscellaneous records properly and bind or file, ready for continued use and reference. Submit one (1) hard copy and one (1) electronic copy of Project Engineer submittals for VIWAPA's records.
- G. Maintenance Manuals: Organize four (4) copies of operation and maintenance data into suitable sets of manageable size. Bind properly indexed data in individual, heavy-duty, 2-inch (51-mm), 3-ring, vinyl-covered binders, with pocket folders for folded sheet information. Mark appropriate identification on front and spine of each binder. In addition provide one (1) electronic copy of all operation and maintenance data.

PART 2 PRODUCTS

Not Applicable

PART 3 EXECUTION

3.01 CLOSEOUT PROCEDURES

- A. Operation and Maintenance Instructions: Arrange for each Installer of equipment that requires regular maintenance to meet with VIWAPA's personnel to provide instruction and training in proper operation and maintenance according to specifications. Provide instruction by

manufacturer's representatives if installers are not experienced in operation and maintenance procedures.

- B. As part of instruction for operating equipment, demonstrate startup, shutdown, emergency operations, noise and vibration adjustments and safety procedures. This documentation will occur after approval of the Engineer and VIWAPA.

3.02 FINAL CLEANING

- A. General: The General Conditions require general cleaning during construction.
- B. Cleaning: Employ professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion.
 - a. Remove labels that are not permanent labels.
 - b. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films, and similar foreign substances. Restore reflective surfaces to their original condition. Leave concrete floors broom clean.
 - c. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean light fixtures and lamps.
 - d. Clean the site of rubbish, litter, and other foreign substances. Sweep paved areas broom clean; remove stains, spills, and other foreign deposits. Rake grounds that are neither paved nor planted to a smooth, even-textured surface.
- C. Removal of Protection: Remove temporary protection and facilities installed for protection of the Work during construction.
- D. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on VIWAPA's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from the site and dispose of lawfully.
 - 1. Where extra materials of value remain after completion of associated Work, they become VIWAPA's property. Dispose of these materials as directed by VIWAPA.

END OF SECTION

SECTION 01730 - GUARANTEES AND WARRANTIES

1. GENERAL

- A. The Contractor shall warrant all equipment, materials, products, and workmanship provided by the Contractor under these Contract Documents for a period of twelve (12) months after the date of final acceptance of the work by the Owner.
- B. If, during the warranty period (a) any equipment, materials, or products furnished and/or installed by the Contractor are found to be defective in service by reason of the Contractor's faulty process, structural and/or mechanical design or specifications, or (b) any equipment, materials, or products furnished and/or installed by the Contractor are found to be defective by reason of defects in material or workmanship, the Contractor shall, as soon as possible after receipt of written notice from the Owner, repair or cause to be repaired such defective equipment, materials or products, or replace such defective equipment, materials or products.
- C. In the event of multiple equipment failures or major consequence prior to the expiration of the one-year warranty described above, the affected equipment shall be disassembled, inspected, and modified or replaced as necessary to prevent further occurrences. All related components which may have been damaged or rendered non-serviceable as a consequence of the equipment failure shall be replaced. A new twelve (12) month warranty against defective or deficient design, workmanship, and materials shall commence on the day that the item of equipment is reassembled and placed back into operation. As used herein, multiple equipment failures shall be interpreted to mean two (2) or more successive failures of the same kind in the same item of equipment or failures of the same kind in two (2) or more items of equipment. Major equipment failures may include, but are not limited to, cracked or broken housings, piping, or vessels, excessive deflections, bent or broken shafts or structural members, broken or chipped gear teeth, overheating, premature bearing failure, excessive wear, or excessive leakage around seals. Equipment failures which are directly and clearly traceable to operator abuse, such as operating the equipment in conflict with published operating procedures, or improper maintenance, such as substitution of unauthorized replacement parts, use of incorrect lubricants or chemicals, flagrant over- or under-lubrication, and using maintenance procedures not conforming with published maintenance instructions, shall be exempted from the scope of the one-year warranty. Should multiple equipment failures occur in a given item or type of equipment, all equipment of the same size and type shall be disassembled, inspected, modified or replaced, as necessary, and re-warranted for one year.

2. START-UP OF OPERABLE COMPONENTS

- A. Because of the need to maintain operation during construction, it will be necessary to accept and start-up operable components of the project at various times prior to the completion and final acceptance of the entire project.

- B. A component of the project, as used herein, shall mean a complete process subsystem and shall include all associated structures, equipment, piping, controls, etc.
- C. When a component of the project has been completed, checked out, field-tested, and made ready for operation, the Contractor shall notify the Engineer in writing that the component is substantially complete and request an inspection for substantial completion. The Engineer will schedule the inspection within 10 days of the Contractor's request. If he concurs in the Contractor's statement, the Engineer will notify the Contractor in writing that the component is accepted as substantially complete. At the same time, the Engineer will submit to the Contractor a list of items, which must be completed or corrected before final acceptance can be given.
- D. If a component of the project is needed in order to maintain operation during construction and if it has been accepted as substantially complete, the Contractor shall start up the component when directed by the Engineer. Once the component has achieved stable and satisfactory operation (minimum 95 percent availability over a 7-day period), the Contractor shall request beneficial occupancy by the Owner. The Owner, if he concurs in the Contractor's statement, that stable and satisfactory operation has been achieved, will notify the Contractor in writing within 10 days that he is assuming beneficial occupancy of the component.
- E. On the date that the Owner assumes beneficial occupancy, the following shall occur:
 - 1. The one-year warranties for the component specified in Part 1.01 of this section will begin; and
 - 2. The Owner will assume responsibility for operating and maintaining the component

END OF SECTION

DIVISION 26
ELECTRICAL

SECTION 260513 - MEDIUM-VOLTAGE CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. Section includes cables and related cable splices, terminations, and accessories for medium-voltage electrical distribution systems.

1.3 DEFINITIONS

- A. Jacket: A continuous nonmetallic outer covering for conductors or cables.
- B. NETA ATS: Acceptance Testing Specification.
- C. Sheath: A continuous metallic covering for conductors or cables.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of cable. Include splices and terminations for cables and cable accessories.

1.5 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type of cable and accessory.
- B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with IEEE C2 and NFPA 70.

- C. Source Limitations: Obtain cables and accessories from single source from single manufacturer.

2.2 CABLES

- A. Cable Type: Type MV 105.
- B. Conductor Insulation: Crosslinked polyethylene or Ethylene-propylene rubber.
 - 1. Voltage Rating: 15 kV.
 - 2. Insulation Thickness: 133% insulation level.
- C. Conductor: 1/C #750 kemil copper.
- D. Comply with UL 1072, AEIC CS8, and ICEA S-94-649.
- E. Conductor Stranding: Compressed round, Class B.
- F. Strand Filling: Conductor interstices are filled with impermeable compound.
- G. Shielding: Solid copper wires, helically applied over semiconducting insulation shield. Provide 1/3 neutral.
- H. Cable Jacket: Sunlight-resistant PVC or Chlorosulfonated polyethylene.

2.3 CABLE TERMINATIONS AT GIS

- A. Furnish and install terminations in accordance with GIS manufacturers requirements, guidelines and installation instructions.

2.4 CABLE TERMINATIONS AT POWER TRANSFORMER & RISER POLES

- A. Shielded-Cable Terminations: Comply with the following classes of IEEE 48. Insulation class shall be equivalent to that of cable. Include shield ground strap for shielded cable terminations.
 - 1. Class 1 Terminations: Modular type, furnished as a kit, with stress-relief tube; multiple, molded-silicone-rubber, insulator modules; shield ground strap; and compression-type

2.5 FAULT INDICATORS

- A. Indicators: Automatically reset fault indicator with inrush restraint feature, arranged to clamp to cable sheath and provide a display after a fault has occurred in cable. Instrument shall not be affected by heat, moisture, and corrosive conditions and shall be recommended by manufacturer for installation conditions.
- B. Install fault indicators under GIS Platform

2.6 SOURCE QUALITY CONTROL

- A. Test and inspect cables according to ICEA S-94-649 before shipping.
- B. Test strand-filled cables for water-penetration resistance according to ICEA T-31-610, using a test pressure of 5 psig.
- C. Provide a copy of test reports to Engineer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cables according to IEEE 576.
- B. Proof conduits prior to conductor installation by passing a wire brush mandrel and then a rubber duct swab through the conduit. Separate the wire brush and the rubber swab by 48 to 72 inches on the pull rope.
 - 1. Wire Brush Mandrel: Consists of a length of brush approximately the size of the conduit inner diameter with stiff steel bristles and an eye on each end for attaching the pull ropes. If an obstruction is felt, pull the brush back and forth repeatedly to break up the obstruction.
 - 2. Rubber Duct Swab: Consists of a series of rubber discs approximately the size of the conduit inner diameter on a length of steel cable with an eye on each end for attaching the pull ropes. Pull the rubber duct swab through the duct to extract loose debris from the duct.
- C. Pull Conductors: Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
 - 1. Where necessary, use manufacturer-approved pulling compound or lubricant that does not deteriorate conductor or insulation.
 - 2. Use pulling means, including fish tape, cable, rope, and basket-weave cable grips, that do not damage cables and raceways. Do not use rope hitches for pulling attachment to cable.
 - 3. Use pull-in guides, cable feeders, and draw-in protectors as required to protect cables during installation.
 - 4. Do not pull cables with ends unsealed. Seal cable ends with rubber tape.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
- E. In manholes, handholes, pull boxes, junction boxes, and cable vaults, train cables around walls by the longest route from entry to exit; support cables at intervals adequate to prevent sag.
- F. Install sufficient cable length to remove cable ends under pulling grips. Remove length of conductor damaged during pulling.

- G. Install terminations at ends of conductors, and seal multiconductor cable ends with standard kits.
- H. Install fault indicators on each phase.
- I. Identify cables according to Section 260553 "Identification for Electrical Systems." Identify phase and circuit number of each conductor at each termination and pull point. Arrange identification so that it is unnecessary to move the cable or conductor to read the identification.

3.2 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor shall engage a qualified third-party testing agency to perform tests and inspections.
- B. Perform the following tests and inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
 - 2. After installing medium-voltage cables and before electrical circuitry has been energized, test for compliance with requirements.
 - 3. Perform VFL test of each new conductor according to NETA ATS, Ch. 7.3.3. Do not exceed cable manufacturer's recommended maximum test voltage.
 - 4. Perform Partial Discharge test of each new conductor according to NETA ATS, Ch. 7.3.3 and to test equipment manufacturer's recommendations.
 - 5. Perform Dissipation Factor test of each new conductor according to NETA ATS, Ch. 7.3.3 and to test equipment manufacturer's recommendations.
- C. Medium-voltage cables will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 260513

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Building wires rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
- B. Where a specific manufacturers name is listed an equal substitute may be used.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Copper Conductors: Comply with NEMA WC 70.
- B. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN, XHHW.

2.2 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- B. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- C. Exposed Branch Circuits: Type THHN-THWN, single conductors in raceway.
- D. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- E. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- F. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.3 INSTALLATION OF CONDUCTORS

- A. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- B. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, which will not damage cables or raceway.
- C. Identify and color-code conductors according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 FIELD QUALITY CONTROL

- A. Contractor shall perform all tests and inspections and prepare test reports listed below:
 - 1. Transformer secondary feeder.
 - 2. Generator feeder.
 - 3. All panelboard feeders.
 - 4. All three phase equipment feeders.
 - 5. All branch circuit conductors.
- B. Tests and Inspections:
 - 1. After installing conductors and before electrical circuitry has been energized, test conductors feeding the following critical equipment and services for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in ANSI/NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.

3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Warning labels and signs.
5. Instruction signs.
6. Equipment identification labels.
7. Miscellaneous identification products.

1.2 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.

1.3 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
 2. Legend: Indicate voltage and system or service type.
- C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Colors for 15kV cables: Per VIWAPA Standards
- F. Raceways and Cables Carrying Circuits at More Than 600 V:
1. Black letters on an orange field.
 2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."

2.2 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.3 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs:
1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
 2. 1/4-inch grommets in corners for mounting.
 3. Nominal size, 7 by 10 inches.
- D. Warning label and sign shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2.4 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
 - 1. Engraved legend with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
 - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.5 EQUIPMENT IDENTIFICATION LABELS

- A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.6 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Apply identification devices to surfaces that require finish after completing finish work.
- C. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- D. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways, 600 V or Less, for Service, Feeder, Medium Voltage Cable, and Branch Circuits More Than 100A, and 120V to ground: Install labels at 10-foot maximum intervals.

- B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in panels, switchgear enclosures pull and junction boxes, use color-coded conductors to identify the phase.
 - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded conductors.
 - a. Color shall be factory applied tape.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - c. Field-Applied, Color-Coding Conductor Tape: (Only where not practical to provide factory prepared color-coded conductors.) Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- C. Power-Circuit Conductor Identification, More Than 600 V: For conductors manholes, and handholes, use nonmetallic preprinted tags colored and marked to indicate phase, and a separate tag with the circuit designation.
- D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- E. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- F. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
 - 1. Comply with 29 CFR 1910.145.
 - 2. Identify system voltage with black letters on an orange background.
 - 3. Apply to exterior of door, cover, or other access.
- G. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- H. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual.

Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

- a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch high letters on 1-1/2-inch high label; where two lines of text are required, use labels 2 inches high.
- b. Outdoor Equipment: Engraved, laminated acrylic or melamine label 4 inches high.
- c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
- d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

END OF SECTION 260553

SECTION 260800 - ELECTRICAL INSPECTION AND TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Provide labor, materials, temporary wiring, testing equipment, technical supervision and services; perform operations required for electrical and mechanical testing of new electrical equipment and circuits being installed; and operations required for electrical testing of each existing circuit being reconnected.
2. Preliminary inspections and testing.
3. Electrical acceptance testing.

1.2 REFERENCES

- A. The publications listed below form part of this specification. Each publication shall be the latest revision and addendum in effect on the date this specification is issued for construction unless noted otherwise. Except as modified by the requirements specified herein or the details of the drawings, Work included in this specification shall conform to the applicable provisions of these publications.

1. American National Standard Institute (ANSI) / Institute of Electrical and Electronics Engineers (IEEE)
 - a. ANSI/IEEE C37- Guides and Standards for Circuit Breakers, Switchgear, Relays, Substations, and Fuses.
 - b. ANSI/IEEE C57 – Distribution, Power, and Regulation Transformers
 - c. IEEE 81 – IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.

- d. ANSI/IEEE 142 - IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems (IEEE Green Book)
 - e. ANSI/IEEE 242 – IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power System (Buff Book)
 - f. ANSI/NETA ATS– Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems.
2. National Fire Protection Association –NFPA
- a. ANSI/NFPA 70 – National Electrical Code
 - b. ANSI/NFPA 70E – Standard for Electrical Safety in the Workplace.

1.3 SYSTEM DESCRIPTION

- A. Electrical acceptance tests shall be conducted to ensure that electrical materials and their installations are in accordance with the Contract Documents, regulatory agencies, applicable codes and standards listed herein, and that they may be safely energized.

1.4 SUBMITTALS

- A. Quality Control Submittals: Submit copies of test reports in accordance with requirements of individual Sections and with the following:
 - 1. Submit copies of test reports to the Engineer including actual readings and corrected readings after each test period.
 - 2. Submit bound copies of final approved test reports at completion of tests to Engineer. Also, maintain copies of these test reports at the site.
 - 3. Test reports shall be signed by persons performing tests and witnesses to tests and shall include but not be limited to the following data:
 - a. Date of test
 - b. Description of equipment tested
 - c. Description of test
 - d. Environmental conditions (Temperature, humidity and weather)
 - e. Test results (Actual values measured)
 - f. Comments: Conclusions and recommendations

B. Quality Assurance Summary: Submit documentation upon request by Owner or Engineer.

1.5 Preliminary testing and visual inspections shall be conducted prior to acceptance and operational tests to avoid delays.

- A. Provide qualified testing personnel, materials and calibrated test equipment to perform inspection and testing.
- B. Testing and equipment used for testing shall conform to the latest edition of reference specifications specified herein and to applicable codes and requirements of VIWAPA.
- C. Review operating instruction and maintenance manuals prior to field testing equipment.
- D. Testing Agency shall be regularly engaged in the testing of electrical equipment, devices, installations, and systems in the voltage levels used on this project. Testing Agency shall submit proof of the above qualifications when requested.

1.6 Schedule tests with approval of VIWAPA. Schedule to be coordinated with VIWAPA.

PART 2 - EXECUTION

2.1 GENERAL

- A. This specification provides guidelines for the inspection, testing, and checkout of the electrical system to ensure that the electrical installation is in accordance with the design specifications, drawings, and Manufacturer's instructions.
- B. The listings and descriptions of the inspections, tests, and checks described herein shall not be considered as complete and all inclusive. Additional normal standard construction (and sometimes repetitive) checks and test may be necessary throughout the job.
- C. Inspection and test work shall be coordinated with VIWAPA's Project Manager. Reasonable notice shall be given to VIWAPA to allow witnessing for those tests designated to be witnessed.

Where indicated in Contract Documents, specific tests shall be performed by a Testing Agency with the following qualifications:

- 1. Testing firm shall be regularly engaged in testing of electrical equipment, devices, installations and systems.
- 2. Testing laboratory shall meet Federal Occupational Safety and Health Administration (OSHA) requirements for accreditation of independent testing laboratories, Title 29, part 1907.

2.2 Lead, onsite technical person of Testing Agency shall be currently certified by the National Institute for Certification in Engineering Technologies (NICET) in electrical power distribution system testing.

- A. Equipment or circuitry shall not be energized, de-energized, or tied-in to a system without prior review and approval of the test plan and procedure by the site electrical superintendent and the owner's representative.
- B. Construction Quality Manager / Supervisor shall be responsible for all inspection and test activities.
- C. Inspector and test technicians shall be qualified for the work by virtue of training and experience.
- D. Examine areas and conditions under which testing will be done. Do not proceed with the work until satisfactory conditions have been achieved.

2.3 APPLICATION

- A. Equipment that can be paralleled under any conditions including defeat of the interlock shall be tested for proper phasing using hot-phase hot-stick or other approved methods.
- B. Megger values as specified are minimum acceptance values at ambient temperature of 60 degrees F and low relative humidity. Convert readings to equivalent values at 60 degrees F if measurements are taken under other conditions.
- C. Check and verify phase rotation at switchgear and transformer using a phase sequence meter for consistency and conformity to recognized standards, i.e., A-B-C left to right, top to bottom, front to back, when facing front of equipment. Phase rotation shall conform to existing.

2.4 EQUIPMENT INSPECTION: In general, inspect electrical equipment as follows or for the following:

- A. Proper installation, support and fastening.
- B. Complete assembly of components and removal of shipping material.
- C. Tightness of bolted covers, proper gasket fit and missing hardware.
- D. Tightness and physical condition of bolted connections, both electrical and structural.
- E. Proper support and termination of power and control wiring.
- F. Secure ground connections.

- G. Verify that instrument transformers, instruments, control relays, fuses, circuit breakers, switches and other devices are of proper type, size and rating.
- H. Damage to equipment sheet metal and components including paint finish, cleanliness inside and out.
- I. Proper operation of doors, latches, and locks.
- J. Verify labeling is affixed per site standard, and is clearly visible.

2.5 PREPARATION

- A. A detail plan and schedule shall be prepared for inspection and testing activities.
- B. It is important that equipment warranties or guarantees shall not be voided by testing and checkout work.
- C. The checks and tests shall normally be supplemental to and compatible with the manufacturers' installation instruction leaflets and literature.
- D. Where deviations are apparent, the manufacturer's review shall be obtained before testing.
- E. Reasonable cooperation shall be extended to permit witnessing by the manufacturer's representative if so requested.
- F. Where any questionable repairs, modifications, significant adjustments, tests, or checks are to be made, the test supervisor shall contact the electrical superintendent to determine if the work should be performed by or with the manufacturer's representative.
- G. Serial and model numbers of the instruments used shall be recorded on the test forms.
- H. Testing and checkout work shall be performed with fully qualified personnel skilled in the particular tests being conducted. This is essential for obtaining and properly evaluating data while the tests are in progress, and for ensuring that important facts and questionable data are reported.
- I. The test apparatus shall be of the proper voltage class and rating for the test being performed. Care shall be taken that the installation shall not be overstressed.
- J. Initial resistance and low voltage tests of equipment shall be made with the equipment de-energized and with all electrical connections to the devices disconnected and locked out as required.
- K. If resistance measurements on devices meet requirements, testing may proceed. Any short or ground shall be repaired, replaced, dried out, or otherwise corrected before the circuit is energized.

- L. Full voltage tests on circuits and equipment shall be performed only upon Owner's approval. Owner's representative shall be present and witness full voltage tests. The manufacturer's representative may also witness full voltage tests.
- M. At any stage of construction, and when observed, electrical equipment or systems determined to be damaged, faulty, or requiring repairs shall be reported to Owner's representative. Corrective action may require prior approval.
- N. Examine the Contract Documents in order to ensure completeness of the Work required under this Section.
- O. Cooperate in coordination and scheduling of Work of the Section with Work of related trades, so as not to delay the Work.
- P. Station personnel at each location where exposed cables, bus work, connections or other components exist during megger and VLF cable testing for safety.
- Q. Clean equipment thoroughly prior to testing. Vacuum interiors of cubicles and remove foreign material. Wipe clean insulators, bushings and bus supports using lint free cloth.
- R. Preliminary tests and visual inspections of electrical installation including verification checks of factory wiring shall be conducted prior to electrical acceptance and operational tests to avoid delays, and to ensure that equipment and installations are free of faulty conditions prior to application of test voltages.
- S. Where equipment or system under test is interrelated with and depends upon other equipment, systems and controls for proper operation, functioning and performance, latter shall be operated simultaneously with equipment or system under test.
- T. Verify that shipping devices and restraints have been removed.
- U. Check for proper interconnection and tightness at all connections of shipping sections

2.6 SAFETY

- A. Safety practices shall include, but are not limited to, the following requirements:
 - 1. OSHA
 - 2. Applicable state, local safety codes and operating procedures
 - 3. American National Standards for Personnel Protection
 - 4. National Fire Protection Association, NFPA 70E
 - 5. National Electrical Safety Code (NESC)

6. VIWAPA safety practices
- B. The test supervisor shall ensure that testing and checkout work is conducted in a safe manner. Special safety precautions such as the following shall be utilized:
1. Locking and tagging procedures.
 2. Barricades.
 3. De-energization or isolation of equipment before testing.
 4. Review of procedures with safety personnel.
 5. Erection of warning signs.
 6. Stationing of guards and watchmen.
 7. Maintenance of voice communications.
 8. Personnel orientation.
 9. Review and understanding of construction documents.
 10. Review and understanding of installation, start up and O & M manuals.
 11. Exposed live parts subjected to testing shall be guarded by personnel, barricades, or other practical means to insure against personnel being injured by coming in contact with or close proximity to exposed live parts.
 12. Equipment, exposed live parts, etc. shall be completely discharged by grounding or other accepted methods to eliminate possibility of injury to personnel from electrical shock after tests have been completed.
 13. Exposed rotating or moving parts of equipment shall be guarded by personnel, barricades or other practical means to insure against personnel being injured during testing of such equipment.
 14. Provide suitable safety equipment, which is readily accessible during testing operations and follow Owner's on site safety regulations.
 15. Tests shall be performed with apparatus de-energized. Exceptions must be thoroughly reviewed to identify safety hazards and devise adequate safeguards.

2.7 SPECIFIC EQUIPMENT AND CABLE TESTING

A. Switchgear Assemblies

1. Compare equipment nameplate data with drawings and specifications.
2. Inspect physical and mechanical condition.
3. Inspect anchorage, alignment, grounding, and required area clearances.
4. Verify the unit is clean and all shipping bracing, loose parts, and documentation shipped inside cubicles have been removed.
5. Inspect and service mechanical operator and SF₆ gas insulated system in accordance with the manufacturer's published data.
6. Verify operation and sequencing of interlocking systems.
7. Verify that each fuse holder has adequate mechanical support and contact integrity.
8. Verify that fuse sizes and types are in accordance with drawings.
9. Test for SF₆ gas leaks in accordance with manufacturer's published data.
10. Verify the unit is clean and all shipping bracing, loose parts, and documentation shipped inside cubicles have been removed.
11. Verify that current and voltage transformer ratios correspond to approved shop drawings.
12. Inspect bolted electrical connections for high resistance using one or more of the following methods:
13. Use of a low-resistance ohmmeter in accordance with Section 7.1.2. of ANSI/NETA ATS.
14. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or Table 100.12. ANSI/NETA ATS.
15. Confirm correct operation and sequencing of electrical and mechanical interlock systems.
16. Attempt closure on locked-open devices. Attempt to open locked-closed devices.
17. Make key exchange with devices operated in off-normal positions.

18. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
19. Inspect insulators for evidence of physical damage or contaminated surfaces.
20. Verify correct barrier and shutter installation and operation.
21. Exercise all active components.
22. Inspect mechanical indicating devices for correct operation.
23. Verify that filters are in place and vents are clear.
24. Perform visual and mechanical inspection of instrument transformers in accordance with Section 7.10 of ANSI/NETA ATS.
25. Perform resistance measurements through bolted electrical connections with a low-resistance ohmmeter, if applicable, in accordance with Section 7.1.1.
26. Perform insulation-resistance tests on each bus section, phase-to-phase and phase-to-ground, for one minute in accordance with Table 100.1.
27. Perform a dielectric withstand voltage test on each bus section, each phase-to-ground with phases not under test grounded, in accordance with manufacturer's published data. If manufacturer has no recommendation for this test, it shall be in accordance with Table 100.2 of ANSI/NETA ATS. The test voltage shall be applied for one minute.
28. Perform electrical tests on instrument transformers in accordance with Section 7.10 of ANSI/NETA ATS
29. Perform ground-resistance tests in accordance with Section 7.13 of ANSI/NETA ATS.
30. Verify correct secondary voltage by energizing the primary winding with system voltage. Measure secondary voltage with the secondary wiring disconnected.
31. Verify correct function of control transfer relays located in the switchgear with multiple control power sources (source transfer switch).
32. Perform system function tests.
33. Verify operation of switchgear space heaters.

34. Perform phasing checks on dual-source switchgear to insure correct bus phasing from each source.

B. Protective Relays
Visual and Mechanical Inspections

1. Record model number, style number, serial number, firmware revision, software revision, and rated control voltage.
2. Verify operation of light-emitting diodes, display, and targets.
3. Record passwords for all access levels.
4. Clean the front panel and remove foreign material from the case.
5. Check tightness of connections.
6. Verify that the frame is grounded in accordance with manufacturer's instructions.
7. Set the relay in accordance with the coordination study.
8. Download settings from the relay. Print a copy of the settings for the report and compare the settings to those specified in the coordination study.

Electrical Tests

1. Perform insulation-resistance tests from each circuit to the grounded frame in accordance with manufacturer's published data.
2. Apply voltage or current to all analog inputs and verify correct registration of the relay meter functions.
3. Functional Operation
Check functional operation of each element used in the protection scheme as described for electromechanical and solid-state relays in 7.9.1.3.
4. Control Verification
 - a) Functional tests
 - 1) Check operation of all active digital inputs.
 - 2) Check all output contacts or SCRs, preferably by operating the controlled device such as circuit breaker, auxiliary relay, or alarm.
 - 3) Check all internal logic functions used in the protection scheme.
 - 4) Upon completion of testing, reset all min/max recorders, communications statistics, fault counters, sequence of events recorder, and all event records.

- b) In-service monitoring
After the equipment is initially energized, measure magnitude and phase angle of all inputs and compare to expected values.

C. Instrument Transformers

Test Values - Visual and Mechanical

1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value. (7.10.1.6.1)
2. Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.12. (7.10.1.6.2)
3. Results of the thermographic survey shall be in accordance with Section 9. (7.10.1.6.3)

Test Values – Current Transformers – Electrical

1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
2. Insulation-resistance values of instrument transformers shall not be less than values shown in Table 100.5.
3. Polarity results shall agree with transformer markings.
4. Ratio errors shall be in accordance with C57.13.
5. Excitation results shall match the curve supplied by the manufacturer or be in accordance with ANSI C57.13.1.
6. Measured burdens shall be compared to instrument transformer ratings.
7. Insulation-resistance values of instrument transformers shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.5.
8. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the primary winding is considered to have passed the test.
9. Power-factor or dissipation-factor values shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use test equipment manufacturer's published data.

10. Test results shall indicate that the circuits have only one grounding point.

Test Values –Voltage Transformers – Electrical

1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
2. Insulation-resistance values of instrument transformers shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.5.
3. Polarity results shall agree with transformer markings.
4. Ratio errors shall be in accordance with C57.13.
5. Measured burdens shall be compared to instrument transformer ratings.
6. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the primary windings are considered to have passed the test.
7. Power-factor or dissipation-factor values shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use test equipment manufacturer's published data.
8. Test results shall indicate that the circuits are grounded at only one point.

D. Metering Devices

Visual and Mechanical Inspection

1. Compare equipment nameplate data with drawings and specifications.
2. Inspect physical and mechanical condition.
3. Inspect cover gasket, cover glass, condition of spiral spring, disk clearance, contacts, and case- shorting contacts, as applicable.
4. Verify the unit is clean.
5. Verify freedom of movement, end play, and alignment of rotating disk(s).

Electrical Tests

1. Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable, in accordance with Section 7.11.1.1.
2. Verify accuracy of meters at all cardinal points.

3. Calibrate meters in accordance with manufacturer's published data.
4. Verify all instrument multipliers.
5. Verify that current transformer and voltage transformer secondary circuits are intact.

Test Values – Visual and Mechanical

1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value. (7.11.1.1.3.1)
2. Bolt-torque levels should be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.12. (7.11.1.1.3.2)
3. Results of the thermographic survey shall be in accordance with Section 9. (7.11.1.3.3)

Test Values – Electrical

1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
2. Meter accuracy shall be in accordance with manufacturer's published data.
3. Calibration results shall be within manufacturer's published tolerances.
4. Instrument multipliers shall be in accordance with system design specifications.
5. Test results shall confirm the integrity of the secondary circuits of current and voltage transformers.

E. Medium Voltage Power Cable

1. Conduct cable tests on new cables in accordance with ICEA-CEMA, NETA, and AEIC specifications, and at the maximum durations and direct current potentials specified herein.
2. Perform cable tests when the cable is received at the project location, and after cables are installed and all splices and terminations are complete, and before connection of any apparatus, equipment, or bus.
3. For additional test requirements, refer to SECTION 26 05 13 – Medium Voltage Cables. The maximum test criteria stated shall apply.

4. Do not energize cables at system voltage before acceptance testing, but do so as promptly as possible after successful completion of tests.
 5. Perform an insulation resistance test for each phase conductor with other conductors and shields solidly grounded. Do not test phase conductors simultaneously.
 6. Test duration shall be 10 minutes with resistances tabulated at 30-second, 1-minute, and 10-minute intervals. Calculate dielectric absorption ratio and polarization index.
 7. Minimum acceptable insulation resistance shall be 1 megohm per 1000 volts of operating voltage.
 8. Perform Very Low Frequency (VLF) test on cables in accordance with 26 05 13 “Medium Voltage Cables” and cable manufacturers standards. Adhere to precautions and limits as specified in the applicable NEMA standard for the specific cable. Perform tests in accordance with ANSI / IEEE Standard 400.
 9. Apply grounds for a time period adequate to drain all insulation stored charge. Proper notification must be made to all concerned parties if grounds are left in place.
- F. 600 Volt Wire and Cable
1. Compare cable data with drawings and specifications.
 2. Perform continuity test to insure correct cable connection.
 3. Verify that cable exhibits continuity.
 4. Verify uniform resistance of parallel conductors.
 5. Investigate deviations in resistance values.
 6. Inspect exposed sections of cable for physical damage.
 7. Inspect bolted electrical connections for high resistance using one or more of the following methods:
 - a. Use of low-resistance ohmmeter.

- b. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench in accordance with manufacturer's published data.
- 8. Check cables and wires for proper identification numbering or color coding.
- 9. Inspect compression-applied connectors for correct cable match and indentation.
- 10. Inspect cable jacket insulation and condition.
- 11. Inspect for correct identification and arrangements.
- 12. Perform insulation-resistance tests on each conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts dc for 300-volt rated cable and 1000 volts dc for 600-volt rated cable. Test duration shall be one minute. Insulation resistance values shall be in accordance with ANSI/NETA ATS, Table 100.1.
- 13. Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of published data, use ANSI/NETA ATS Table 100.12.
- 14. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50% of the lowest value.

G. Grounding Systems

- 1. Visually inspect systems, raceway, and equipment grounds to determine the adequacy and integrity of the grounding.
- 2. Verify ground system is in compliance with drawings, specifications, and NFPA 70 National Electrical Code Article 250, NESC and IEEE 81.
- 3. Inspect physical and mechanical condition.
- 4. Inspect bolted electrical connections for high resistance using one or more of the following methods:
 - a. Use of low-resistance ohmmeter.
 - b. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench in accordance with manufacturer's published data.
- 5. Grounding system electrical and mechanical connections shall be free of corrosion.

6. Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of published data, use ANSI/NETA ATS Table 100.12.

2.8 INSPECTION AND TEST OF ELECTRICAL INSTALLATION

- A. Contractors shall carefully review installation specifications issued for the project. They shall be familiar with applicable codes / standards and shall have copies available at the work locations for reference. Certain requirements may be defined in the specifications but not called out on drawings.
- B. Additional inspections may be carried out by third parties to meet legal requirements. City, state, or similar inspection shall not alleviate the requirement for inspection defined here.

2.9 TEST METHODS OF EQUIPMENT AND CABLE

A. General

1. Contractor shall perform, DC insulation tests of the type specified on electrical equipment, apparatus, and cables as described below:
 - a. Before the energization or placing into service and acceptance by Owner.
 - b. When damage to the insulation is suspected or known to exist.
 - c. After the repairs or modifications to the equipment affecting the installation.
 - d. Insulation tests are required at various stages of construction. The equipment, cable and systems that require testing, the maximum test voltages, and the type test required are specified under the specific equipment type.

B. Insulation Test Methods

1. Three types of insulation tests are generally required by this specification. They are briefly described below. At the conclusion of DC tests, grounds shall be applied to the cable or equipment windings for at least twice as long as the duration of the applied voltage. This is needed to discharge the capacitive voltage built up during the test.
 - a. **Proof Test**
Test requires the application of DC voltage in excess of the equipment rating. The test voltage is held constant for a specified time and the behavior of the insulation current, voltage, and resistance are observed for changes that may indicate approaching failure or poor insulation conditions. The magnitude of the insulation resistance is also considered in the evaluation of the insulation. This test may be conducted with a constant voltage megger or variable voltage source as appropriate.

b. Step Voltage Test

In this test, the voltage is applied to the insulation in consecutive steps of specified magnitude to a maximum value in excess of the equipment rating. The voltage is held constant at each step for a selected period of time, usually 1 minute. At the end of each period, the insulation resistance is determined by the measurement of the current and voltage. A curve of resistance versus voltage is plotted as the data is obtained. At the final test voltage step, the voltage is usually held constant for an additional period of time, usually 3 minutes, and readings taken at 1 minute intervals. The behavior of the meters is closely observed during the entire test. The test is stopped at any voltage step if results show questionable insulation.

c. Megger or Insulation Resistance Test

A simple, short test where DC voltage of 100 to 2500 volts is applied to a cable or winding from a constant source of potential. The voltage is usually considerably below the maximum test value permitted. The insulation resistance is read directly off the indicator and is in megohms. The quality of the insulation is evaluated based on the level of insulation resistance.

END OF SECTION 260800.01

SECTION 261323 – 15KV GAS INSULATED SWITCHGEAR (GIS)

PART 1 - GENERAL

1.1 SUMMARY

- A. Scope: Provide labor, material, equipment, related services, and supervision required including, but not limited to, manufacturing, fabrication, erection, and installation for medium voltage metal-enclosed gas-insulated switchgear (also identified as MV GIS SWGR, GIS SWGR, SWGR, MV CB) as required for the complete performance of the work, and as shown on the Drawings and as herein specified.
- B. Section Includes: The work specified in this Section includes, but shall not be limited to, the following:
 - 1. Medium voltage (15 kV and below) gas insulated arc-resistant switchgear with vacuum circuit breakers.
- C. Related Sections: Related sections include, but shall not be limited to, the following:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - 2. Applicable general requirements for electrical Work specified within Division 26 Specification Sections apply to this Section.
 - 3. The following information is depicted on the Drawings: bus configuration, bus ratings, interrupting ratings, circuit breaker ratings, circuit breaker protective relaying, elevation and footprint, etc. Where not shown on or able to be derived from the Drawings, the minimum requirements specified herein shall be provided.

1.2 REFERENCES

- A. 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. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.
 - 1. Publications:
 - a. ASTM B117, "Standard Practice for Operating Salt Spray (Fog) Apparatus."
 - b. ASTM D1654, "Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments."
 - c. ASTM D2472, Standard Specification for Sulfur Hexafluoride
 - d. IEC 60376, Specification and acceptance of new sulfur hexafluoride.

- e. IEEE C37.122.2 IEEE Guide for Application of Gas Insulated Substations 1kV to 52kV.
- f. IEEE C37.122.3 IEEE Guide for Sulfur Hexafluoride (SF₆) Gas Handling for High Voltage (over 1000Vac) Equipment.
- g. IEEE C37.04 Standard Rating Structure for AC High-Voltage Circuit Breakers
- h. IEEE C37.06 IEEE Standard for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis – Preferred Ratings and Related Required Capabilities for Voltage Above 1000 V.
- i. IEEE C37.09 IEEE Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
- j. IEEE 693 IEEE Recommended Practices for Seismic Design of Substations.
- k. IEEE C37.20.2 IEEE Standard for Metalclad Switchgear.
- l. IEC 61634, High-voltage switchgear and controlgear – Use and handling of sulfur hexafluoride in high-voltage switchgear.
- m. IEC 62271-1, High-voltage switchgear and controlgear – Part 1: Common specifications.
- n. IEC 62271-100, High-voltage switchgear and controlgear, Part 100: High voltage alternating – current circuit-breakers.
- o. IEC 62271-102, High-voltage switchgear and controlgear, Part 102: Alternating current disconnect switches and earthing switches.
- p. IEC 62271-200, High-voltage switchgear and controlgear, Part 200: AC metal enclosed switchgear and controlgear for rated voltages above 1kV and up to including 52kV.
- q. IEC 62271-303, High-voltage switchgear and controlgear, Part 303: Use of handling of Sulphur hexafluoride (SF₆)
- r. IEC 60044-1, “Instrument Transformers - Part 1: Current Transformers.”
- s. IEC 60044-2, “Instrument Transformers - Part 2: Inductive Voltage Transformers.”
- t. IEC 60529, “Degrees of Protection Provided by Enclosures (IP Code).”
- u. NFPA 70 National Electrical Code,” hereinafter Referred to as NEC
- v. ISO 9001, “Quality Management Systems - Requirements”
- w. ICC IBC, “International Building Code.”

1.3 DEFINITIONS

- A. Unless specifically defined within the Contract Documents, the words or acronyms contained within this specification shall be as defined within, or by the references listed within this specification, the Contract Documents, or, if not listed by either, by common industry practice.

1. MV: Medium Voltage
2. GIS: Gas Insulated Switchgear

1.4 SUBMITTALS

A. Submit with Bid

1. Submit sufficient information to determine compliance with the Contract Documents. Identify submittal data with the specific equipment tags and/or service descriptions to which they pertain. Submittal data shall be clearly marked to identify the specific model numbers, options, and features of equipment and work proposed.
2. Deviations from the Contract Documents shall be indicated within the bid submittal. Each deviation shall reference the corresponding drawing or specification number, show the Contract Document requirement text and/or illustration, and shall be accompanied by a detailed written justification for the deviation.
3. Product Data: Submit product data showing material proposed. Submit sufficient information to determine compliance with the Drawings and Specifications.
 - a. Manufacturer, supplier, and proposal specific contact information
 - b. Manufacturer's catalog data indicating model numbers, equipment specifications and construction features including all furnished options, and accessories
 - c. Enclosure type, NEMA rating, material and finishes
 - d. Certification of UL conformity

B. Shop Drawings (Submit after Contract Award)

1. Drawings, Documentation, and Instruction Manuals shall be submitted in accordance with the requirements set forth in these specifications. All submittals shall be accompanied by a transmittal letter. All drawings and footprints shall be submitted in AutoCAD version 2018 and PDF or latest version on disk with updated As-Builts before the final acceptance.
2. The following drawings shall be submitted for approval:
 - a. General Arrangement Drawings
 - b. Structural Plan and Details of Elevated Platform
 - c. Foundation Loading for GIS
 - d. GIS equipment and supporting Structures
 - e. Physical detail Drawings
 - f. GIS and Panel Layout
 - g. Single-line Diagram
 - h. Gas Schematic Drawing
 - i. Grounding arrangement and ground bus details
 - j. Erection Drawings
 - k. Layout of Gas Monitoring Zones
 - l. Elementary Schematic Drawing (ANSI Format)
 - m. Wiring Schematic Diagrams (ANSI Format)

3. Elementary and wiring schematic drawings shall be drawn according to ANSI standards in AutoCAD version 2018. Each device shall be identified by a unique function number conforming to ANSI C 37.2. A complete circuit shall be shown on a drawing in its entirety for each high voltage device. Each scheme and circuit breaker elementary diagrams for each breaker shall be provided. Typical drawings are not acceptable.
4. The Owner shall review each approval drawing, and return drawing to seller marked as APPROVED, APPROVED WITH CHANGES NOTED, or NOT APPROVED, MAKE CHANGES AS NOTED.
5. Manufacturer shall revise and resubmit drawings until Buyer returns drawings marked APPROVED.

C. Operation & Maintenance (O&M) manuals shall be as follows:

1. Manufacturer, supplier, support, and repair center specific contact information.
2. Manufacturer's standard operation and maintenance data assembled for each size and type of equipment furnished.
3. All configured settings/parameters for adjustable components updated to an as-installed and commissioned stated if different from the factory default. Electronic copies of configuration files shall be provided, on media acceptable to the Owner (e.g. CD, USB stick, etc.), where these configurations can be saved as an electronic file for future upload into replaced or repaired components.
4. List of furnished and recommended spare parts.
5. Statement of extended warranty options and costs.
6. O&M manuals shall be submitted prior to arrival of equipment on site.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer Qualifications: Manufacturer shall be a firm engaged in the manufacture of medium voltage gas insulated vacuum interrupter switchgear of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of ten years.
 - a. The manufacturer shall have a valid ISO 9001 certification and an applicable quality assurance system that is regularly reviewed and audited by a third party registrar. Manufacturing, inspection, and testing procedures shall be developed and controlled under the guidelines of the quality assurance system.
2. Installer Qualifications: Installer shall be a firm that shall have a minimum of five years of successful installation experience with project utilizing medium voltage vacuum interrupter switchgear similar in type and scope to that require for this Project and shall be approved by the manufacturer.

B. All work performed and all materials used shall be in accordance with the National Electrical Code, and with applicable local regulations and ordinances. Process controllers, assemblies, materials, and

equipment shall be listed and labeled by Underwriter's Laboratories or by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prior to delivery to the Project site, ensure that suitable storage space is available to store materials in a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres. Materials shall be protected during delivery and storage and shall not exceed the manufacturer stated storage requirements. As a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. In addition, protect electronics from all forms of electrical and magnetic energy that could reasonably cause damage.
- B. Deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and equipment tag number or service name as identified within the Contract Documents.
- C. Inspect and report any concealed damage or violation of delivery storage, and handling requirements to the Engineer.

1.7 WARRANTY

- A. The manufacturer shall guarantee the GIS equipment, for a minimum period of five (5) years after a certificate of successful energization is provided indicating the GIS furnished to be free from defects of material, workmanship design or construction.

1.8 SPECIAL TOOLS AND SPARE PARTS

- A. The Contractor shall provide a recommended spare parts list with the following information provided as a minimum:
 - 1. Contact information for the closest parts stocking location to the Owner.
 - 2. Critical spare parts shall be identified as those parts being associated with long lead times and/or those being critical to the unit's operation.
 - 3. Maintenance spares shall be identified as being those parts required to regularly perform scheduled maintenance on the furnished equipment. These spares shall include, but shall not be limited to, consumable spares that are required to be exchanged during scheduled maintenance periods.
- B. Spare parts shall be provided for each type and size of unit installed. At a minimum, the following shall be provided:
 - 1. Provide the minimum spare parts recommended by the manufacturer.
 - 2. Provide 1 set of each type of power and control fuse installed within equipment

- C. Any manufacturer specific special tool, not normally found in an electrician's toolbox, required to remove and install recommended or furnished spare parts shall be furnished. At a minimum the following shall be provided:
 - 1. If available from manufacture, provide PC-based configuration software tool and a minimum of one communication interface cable for each type of cable required to connect a PC-based computer to the devices specified herein for configuration and programming.
 - 2. Electronic configuration files, in a media format acceptable by the Owner (e.g. CD, USB stick, etc.), updated to an as-installed and commissioned state.
- D. Spare parts shall be properly marked and packaged for long term storage. Printed circuit boards shall be provided in separate anti-static containers.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Without limiting the generality of other requirements of this Section, all work specified herein shall conform to or exceed the applicable requirements of the following standards; provided, that wherever the provisions of said publications are in conflict with the requirements specified herein, the more stringent requirements shall apply:
 - 1. ANSI/IEEE C37.20.3.
 - 2. ANSI/IEEE C37.010, ANSI/IEEE C37.04, ANSI/IEEE C37.06, ANSI/IEEE C37.09, ANSI/IEEE C37.20.4, and ANSI/IEEE C37.016.
 - 3. ANSI/IEEE C37.54, ANSI/IEEE C37.57, ANSI/IEEE C37.58, and ANSI/IEEE C57.13.
 - 4. NEC and CSA C22.1.
 - 5. CSA C22.2 No. 14, CSA C22.2 No. 31-10, CSA C22.2 No. 58, CAN/CSA C60044-1, and CAN/CSA C60044-2.
 - 6. CSA TIL No. D-25.
 - 7. IEC 60044-1, IEC 60044-2, IEC 60529, IEC 62271-1, IEC 62271-102, IEC 62271-100, and IEC 62271-200.
 - 8. ISO 9001.
 - 9. ICC IBC.

2.2 DESIGN DATA

- A. The GIS will be part of an indoor, three-phase, three-wire, grounded distribution system. All primary components of the GIS (circuit breakers, disconnect switches, grounding switches, busbars, CTs, PTs, cable boxes, etc.) provided under these specifications shall be rated and conform to the latest applicable standards as follows:

▪ Maximum Voltage	17.5 kV rms
▪ Operations Voltage	13.2 kV rms
▪ Frequency	60 Hz
▪ Rated Current	
Main Bus	2,000 Amps
Main Breaker & Switches	2,000 Amps
Feeder Breaker & Switches	1,200 Amps
▪ BIL	95 kV
▪ Short time current	31.5 kA rms for 3 seconds minimum
▪ Power frequency	38 kV, rms
▪ Internal ARC Classification	31.5 kA/15

- B. The GIS shall be installed in a switchgear building on an elevated platform and will be located in St Thomas, USVI at an elevation of less than 100 feet above sea level. The average relative humidity is 90%. The maximum and minimum ambient temperatures are 100°F and 50°F respectively. All primary components shall be designed for use indoor, under local environmental conditions described in these specifications. The GIS design shall take into account significant dust pollution experienced in the local environment.
- C. Each current carrying component of the equipment shall be capable of continuous operation at the specified ratings without exceeding the maximum temperature rises stated in the applicable standards.
- D. The equipment shall be designed and manufactured for satisfactory operation under the following conditions:
1. Seismic: ASCE 7; Site Cass D, 0.2 second spectral response acceleration of 123% g, Importance factor 1.5.

2.3 CONSTRUCTION DETAILS

- A. The assembly shall be metal-clad type and designed such that all components of the switchgear (circuit breaker, busbars, disconnect switches, grounding switches, PTs, CTs, surge arresters, cable terminations, etc.) shall be in a grounded metal enclosure. The construction shall withstand forces, without distortion, caused by closing and opening of the circuit breakers.
- B. Each current carrying component of the equipment shall be capable of continuous operation at the specified ratings without exceeding the maximum temperature rise stated in ANSI standards.
- C. The front of the cubicle shall contain a low voltage compartment, with access to controls, relays, motor drives, and terminal blocks. Opening the low voltage control compartment shall not inhibit operation of the switchgear. The low voltage compartment shall be manufactured in accordance with ANSI standards.

D. Each GIS cubicle shall include the following components:

1. A single busbar system with integrated disconnect switch & ground switch as per attached one line diagram.
2. Vacuum circuit breaker
3. Current transformers as shown on drawings
4. Three-phase Bus Voltage Transformers (cubicle 1 only) with three position disconnect switch
5. Plug-type cable connections
6. Plug-type surge arresters (as shown on drawings)
7. Local control and protection panel (LV compartment) with operating mechanisms for the above mentioned switching devices, view ports, SF₆ gas pressure/density monitors, control wiring, auxiliary relays, terminal blocks, local and remote control equipment, etc.

E. The GIS enclosure shall be SF₆ gas-insulated to the manufacturers recommended pressure, creating a compact and maintenance-free environment. The GIS shall be designed so that installation, testing, normal service, inspection, maintenance, grounding of high voltage cables, locating of cable faults, voltage tests on connected cables, and elimination of electrostatic charges can be carried out safely and without SF₆ gas handling. The layout of the equipment shall provide safe access for operation and maintenance of a section, while the adjacent sections are energized.

F. The GIS shall be capable of sustaining without damage, all stresses produced by fault conditions up to and including the rated short-circuit current specified.

G. The GIS shall be compartmentalized, with each compartment equipped with an over-pressure relief device to provide venting into metal-clad pressure relief ducts on the top of the switchgear, except at the cable termination. Venting into the switchgear building shall not be acceptable. The GIS shall comply with arc-resistant design per IEC 62271-200. Bus bar segments shall be independent and strictly compartmentalized. Bus bar segments shared by several GIS panels shall not be acceptable.

H. The GIS compartments shall consist of gas tight enclosures that can be considered sealed for life. Therefore, topping off or refilling of SF₆ gas shall not be required during normal operation for the expected service life of the GIS (minimum 30 years). The GIS compartments and associated structure shall withstand repeatedly, without distortion, forces caused by closing and opening of the circuit breakers.

I. A continuous ground bus shall run the length of the GIS for effective grounding.

2.4 EXPANSION

A. The GIS shall be designed so that it can be easily extended without having to open gas compartments and without the need for SF₆ gas handling. When extending either end of the GIS, it shall not be necessary to make any modifications to the existing bus bars, except to open the bus bar end covers to extend the bus bar into the new GIS.

2.5 ENCLOSURES

- A. The GIS compartments shall be of metal construction using materials that are naturally resistant to corrosion (such as stainless steel or aluminum). The local control and protection panels shall be made of sheet steel and painted ANSI 70 light gray on the outside, and gloss white enamel on the inside, using acceptable industry standard practices. Instead of interior painting, galvanizing with Aluzinc, Galvalume, or similar materials shall be acceptable.
- B. The division of GIS compartments shall take into account the effects of faults within the compartments such that in the event of an internal fault, there shall be no danger of the internal pressure exceeding the design limits of the compartments. It shall be possible to evacuate individual gas-filled compartments separately for inspection or maintenance, while keeping the adjacent compartments pressurized to rated pressure. The manufacturer shall provide with their proposal, drawings showing the gas segregation zones.
- C. The manufacturer shall guarantee that leakage of gas from the enclosures will not exceed 0.2% of the gas per gas compartment per year.
- D. The degree of protection for the enclosure shall be IP65. The low voltage compartment shall have IP40 degree of protection with doors closed.

2.6 SF₆ SEALS

- A. The GIS enclosures shall be provided with seals at intersections between gas-filled compartments and at positions where sliding or rotating shafts enter a gas-filled compartment. The material for the seals shall be non-deteriorating, and the seals shall be capable of withstanding the gas pressure of the compartments under all service conditions, including seismic events.

2.7 PRESSURE RELIEF DEVICES

- A. As a means of limiting consequences of internal faults, the switchgear shall be provided with pressure relief devices for each compartment to limit the pressure of SF₆ gas to a safe level in the event of an internal fault. Designs where the arc is allowed to burn through the enclosure at designated points shall not be acceptable. The pressure relief devices shall be designed such that discharges resulting from internal faults are directed into a metal-clad arc duct along the switchgear and away from locations where personnel may be present. The metal-clad arc duct plenum shall be vented to the outside of the switchgear building and shall discharge downward. All pressure relief devices shall be certified by an arc fault test in accordance with IEC 62271-200. The manufacturer shall explain in their proposal, how their proposed design meets these requirements.

2.8 INSULATION

- A. Sulfur Hexafluoride (SF₆) gas and epoxy cast resin insulating materials or approved equal shall be employed for the insulation of primary conductors of each phase, from the grounded metal enclosure. The insulating gas shall be pressurized slightly higher than atmospheric pressure. Solid insulators shall be non-hygroscopic, track-resistant epoxy cast resin, free from voids and contaminants. The

contour of the insulators shall be such that a uniform voltage gradient is produced over the entire surface.

2.9 MONITORING

- A. A gas leakage detection system shall be provided for each gas compartment and connected to an alarm system. Provisions for supervisory control monitoring shall be included. Each gas-tight SF₆-filled compartment shall be provided with a temperature-compensated pressure sensitive device to monitor the gas density. If the gas density falls below the preset limits, a relay shall initiate an alarm to the supervisory control monitoring system. An independent gas monitoring system shall be required for each section of the bus bar in every GIS bay. A common gas system for bus bar sections of several GIS bays shall not be acceptable. The GIS system shall be designed to maintain a BIL level of at least 95 kV BIL and a rated interrupting capacity of 31.5 kA in the event the gas pressure drops to atmospheric pressure.

2.10 BUS BAR CONDUCTORS AND JOINTS

- A. Conductors and connectors for the bus bars shall be made of copper, designed to carry continuous 2000 amps respectively in the main and line positions and withstand 31.5 kA rms short circuit currents for 3 seconds. The surfaces of the conductors shall have a smooth finish to prevent any electrical discharges. Disconnect and ground switch contacts shall be of silver-plated spiral spring type to provide good conductivity and shall match the rating of the bus bar or the line. The design of the joints between lengths of bus bars, and from the bus bar to the components shall be of the plug-type to permit easy dismantling for maintenance purposes.

2.11 SUPPORTING INSULATORS

- A. Provide insulating support, which provides a gas-tight barrier of live parts and conductors between compartments. The material of support shall be epoxy or approved equal. The design of the insulating supports shall be such that it is possible to inspect, maintain, or pressurize each compartment individually without interfering with adjacent compartments.

2.12 MIMIC BUS

- A. Each cubicle shall have a mimic diagram of sufficient size and color (Owner determined) contrast to be plainly visible to an operator. Mimic diagrams shall show circuit breakers, maintenance disconnect switches, maintenance grounding switches, cable grounding switches, and bus bar connections at cubicles and control panels, along with color indications at both places. The symbols on the mimic diagrams shall be in accordance with ANSI Y 14.15 and ANSI Y 32.2.

2.13 VACUUM CIRCUIT BREAKERS

- A. DESIGN: Circuit breakers shall be vacuum-type, designed to withstand impacts and vibrations under rated and short-circuit current conditions. The vacuum bottles shall be of high quality to withstand the specified switching duties. (The circuit breakers shall require minimum maintenance.)

- B. Each circuit breaker shall be provided with a suitable mechanically operated indicating device, marked "OPEN" and "CLOSED". The indicating device shall be visible from the front of the panel at all times. Circuit breaker operating mechanism shall be motorized, and equipped with spring charged indicating device. Circuit breaker mechanisms shall be trip free, and designed for operation at 125 VDC. A suitable form of arc control shall be incorporated in the design and the contacts shall be self-cleaning and self-aligning to ensure full contact without undue maintenance.
- C. The circuit breaker shall have a minimum operational life of ten (10) years or 30,000 mechanical operations without maintenance.
- D. The circuit breakers shall be rated in accordance with IEC 62271-100 or ANSI C37.09, whichever is more stringent, and compatible with the GIS system ratings specified in section I. The rated operating sequence (Duty Cycle) shall be O-0.3 sec-CO-3sec-CO for the rated current. The circuit breakers shall be designed to accommodate the TRV (Transient Recovery Voltage) peaks, which occur during the breaking of small inductive currents normally encountered in a high voltage system.
- E. Vacuum circuit breakers shall not produce excessive over-voltage as a result of current chopping. Special design is to be incorporated to reduce the effect of chopping to less than 5 A during any interruption action.
- F. Each circuit breaker shall include two trip coils, and two trip coil monitors, E-MAX RAW – ID/632A304 or equal.

2.14 DISCONNECT AND GROUND SWITCHES

- A. DESIGN: Bus bar disconnecting and circuit grounding shall be accomplished by means of a three position disconnect and grounding switch, located between the bus bar and the main circuit breaker, the transformer and the main circuit breaker and at each feeder cable. The three positions of the disconnect and grounding switch shall be CLOSED, OPEN, and GROUND. Grounding shall follow the sequence described below and shall be fully interlocked to prevent accidental miss-operation:
 - 1. Open the main circuit breaker
 - 2. Open the bus bar disconnect switch
 - 3. Close the bus bar grounding switch
 - 4. Close the lie side disconnect switch
 - 5. Close the circuit breaker
 - 6. Close the cable grounding switch
- B. This design shall permit grounding of the circuit side of the equipment through the circuit breaker and securing the ground on both sides of the circuit breaker.
- C. Both busbar disconnect and grounding switches, transformer disconnect and grounding switches and the cable discontent and grounding switches shall be equipped with view ports to safely verify the switch contact position. In addition, position indicators mechanically linked to the drive shaft shall be provided inside the LV compartment and LED-type indicators on the front-door of the LV compartment.

- D. The manufacturer shall clearly state which means of visible determination of the contact positions they propose and shall include a technical description in their proposal.
- E. The ratings for the three-position switches and the grounding switches shall be coordinated with the system ratings. Provisions for manual operation and electrical motor drive shall be provided, with all three poles of the switch operating simultaneously. The mechanism shall be located in the low voltage compartment, allowing access while the equipment is energized.

2.15 OPERATING MECHANISM

- A. The circuit breaker operating mechanism shall be located in the LV compartment, allowing access from the front of the switchgear while the primary equipment is in service. It shall be possible to lubricate and service the moving parts of the mechanism without dismantling major components. The operating mechanism for the circuit breaker shall have a minimum operational life of ten (10) years or 10,000 operations without maintenance and shall be “trip free” type.
- B. Closing Operation: Closing shall be accomplished by means of a spring operated, stored energy-type mechanism, with electrical release. The mechanism shall be designed such that:
 - 1. The spring must be fully charged to enable closing the breaker.
 - 2. The spring may be charged with the circuit breaker in the closed position. Should the spring be released during charging, the circuit breaker cannot open.
 - 3. A visual, mechanical indicating device shall be provided to indicate the position of the spring. The position indicator shall read “SPRING CHARGED” when the mechanism is fully-charged, and ready to close the circuit breaker, and “SPRING FREE” when it is in any other condition.
 - 4. Manual charging of the spring shall be possible during testing.

2.16 TRIPPING OPERATION

- A. Tripping of the circuit breaker shall be by means of a charged spring. Each mechanism shall be provided with a shunt release and the necessary auxiliary switches. A non-reset operations counter shall be fitted to the mechanism, designed to total all “opening” operations of the interrupter. Provisions for a manual trip lock-out of the circuit breaker shall be furnished. It shall not be possible to defeat the lock-out trip provision.

2.17 MECHANISM CONTROL

- A. Each operating mechanism shall be provided with the following control features at the relay and control panel:
 - 1. Remote electrical close, with provisions for connection to SCADA system.
 - 2. Local electrical close and trip with push button at the circuit breaker. The operating mechanism shall automatically recharge the spring after the completion of a closing operation, with a control switch on each panel to cut off the DC supply to disconnect this facility.
 - 3. Local manual close and trip by control switch (circuit breaker) and by push buttons (all three-position and grounding switches).

4. Local and remote electrical operation of the three-position and grounding switches with automatic cutoff when switch has reached the full open/closed position.
5. Manual operation of three-position and grounding switches. When a disconnect or grounding switch is operated by hand, operation of the motorized mechanism shall be blocked.

2.18 CONTROL/TRANSFER SWITCH

- A. Selector switches shall be of the two-position type (i.e. Local / Remote). Control switches shall be arranged to return automatically to the neutral position when the handle is released after being turned to either the “close” or “trip” position.

2.19 POSITION INDICATION

- A. The following are the minimum position indicators that shall be provided on the front of the switchgear.
 1. Circuit breaker
 - a. Circuit breaker “CLOSED”
 - b. Circuit breaker “OPEN”
 2. Three-position switch
 - a. Disconnect Switch “CLOSED”
 - b. Disconnect Switch and Ground Switch “OPEN”
 - c. Ground Switch “CLOSED”
- B. All the above indicators shall be operated through mechanical means. Additional electrical indicator lamps (LED type) showing the status (e.g. red for circuit breaker “CLOSED” and green for circuit breaker “OPEN”) shall be provided on the front of the low voltage control panel.
- C. Three-position switches and ground switches shall all be provided with view ports to visually verify the contacts position. View ports shall be furnished with a protective cover with warning label.
- D. Any two switching devices which are interlocked together shall be secured by a double operation inhibit system in such a way that if an operating command is issued simultaneously to both devices or if they are both operated manually, their interlocks cannot block both the switches in an undefined, intermediate position. This means that while one device is being operated by hand or by a motorized mechanism, operation of the device interlocked with the former is blocked.

2.20 CABLE & TERMINATION KIT

- A. The manufacturer shall be responsible for the supply of plug-type cable termination kits. The type of termination kits to be supplied with each panel shall be of the pre-molded, plug-in type and shall be designed for use on EPR or XLPE cables up to 750 Kcmil. Detailed cable data to be provided by owner after award of bid.

- B. Each termination kit shall include three suitable lengths of tinned copper braids for the grounding of the cable ground shield. A copper lug shall be crimped at one end of each ground braid. A suitable cover shall be provided and fitted securely at each plug-in cable termination receptacle entry. The covers shall only be removed during cable termination.
- C. The leads from plug-in termination kit for detecting the potential shall be suitably color coded for easy identification.

2.21 INSTRUMENT TRANSFORMERS

A. Current Transformers

1. Current transformers (CT's) shall comply with the requirements of this specification and as indicated in the single-line diagram furnished with this inquiry. CT's shall be multi ratio (C200 class for protection, C400 class for bus differential protection, and 0.3-1.8 class for metering) bushing type, except where otherwise noted on drawings, high accuracy and shall have short-circuit ratings not less than that of the associated GIS. They shall be capable of carrying the rated primary current for a period of one minute with the secondary windings open-circuited as specified in primary current of a period of one minute with the secondary windings open-circuited as specified in ANSI C 37.13.
2. Current transformers for protective relays shall have over-current and saturation factors not less than those corresponding to the design short circuit level of the system.
3. The output of each current transformer shall not be less than that specified, and the bidder shall ensure that the capacity of the current transformers provided is adequate for the operation of the associated protective devices and instruments. These connections and the ratio in use shall be shown on the appropriate connection and schematic diagrams.
4. All secondary connections shall be made to shorting type terminal blocks.

B. Voltage Transformers

1. Single-phase feeder connected VTs shall be provided as specified. They shall comply with ANSI C 37.13 and be of cast resin type.
2. Voltage transformers shall be removable by means of a plug-type connection to the internal bus bar of the switchgear. They shall not be installed inside the SF₆ gas-insulated compartment.
3. VTs shall have secondary protection by means of micro circuit breakers installed and easily accessible in the low voltage control panel. Primary fuses shall not be required.
4. All secondary leads shall be wired to terminal blocks, located in the low voltage compartment.

2.22 PROTECTIVE RELAYS

- A. Protective Relays shall be located in Remote Relay Panels.

2.23 METERING

- A. Metering shall be located in Remote Relay Panels

2.24 MISC.

A. Auxiliary Switches

1. Circuit breakers, isolators and grounding switches shall be provided with suitably rated auxiliary switches for control, indication and protection purposes as required by the relevant sections of this specification. In addition, three normally open and three normally closed auxiliary switch contacts shall be provided for owner use. The connections of all auxiliary switches, coil connections and interconnections between auxiliary switches shall be wired to a terminal board located in the low voltage control panel.

B. Locking Provisions

1. Panel door locking shall be provided for each breaker compartment. Additional locking provisions shall be furnished for the following:
 - a. Circuit breaker mechanisms in the open position and any associated manual operating device in the neutral position.
 - b. Low voltage control cabinet.

C. Nameplates

1. Permanent nameplates shall be provided to identify each component of the switchgear and control panel. Letters shall be white with a black background warning labels shall be provided on each compartment with external circuit. Warning labels shall be red background with white letters.

2.25 WIRING

A. Controls and Protection

1. The local control panel shall be bolted to the front of the switchgear, one for each GIS unit. Each control panel shall be fully equipped and completely wired to the terminal blocks specified herein for all control and monitoring. The cabinet doors shall be equipped with a three-point latching system, operated with a single handle. Operating handle shall have provisions for locking the door shut. Hinges for doors and swing panels shall not permit sagging due to weight of the door or panel and shall have a suitable doorstop. Each cabinet door shall be dust tight and gasketed NEMA 12 construction. The controls for each circuit breaker shall contain the following equipment mounted on the front panel of the low voltage control panel:
 - a. One-Electroswitch Series 24 (or equal) control switch (with pullout for Remote) for each circuit breaker.
 - b. One red indicating light and one green indicating light for each circuit breaker.
 - c. One set of push buttons for each disconnect / ground switch.
 - d. One red indicating light and one green indicating light for each disconnect / ground switch.
 - e. One set of push buttons for each cable ground switch

- f. One red indicating light and one green indicating light for each cable ground switch.
 - g. Mimic diagram as described within this specification.
 - h. All indicating lamps to be cluster LED-type.
2. The controls for each circuit breaker shall also contain the following equipment, located within the low voltage control panel:
- a. Terminal blocks and terminations for each control wire connected to the circuit breaker, disconnect switches, and grounding switches. All terminal blocks shall be GE EB-25 or equal for external connections. A maximum of two wires per terminal shall be permitted.
 - b. Three 15 A, 130 VDC, two-pole fused knife switch for circuit breaker control, and one two-pole fused knife switch for disconnect and grounding switches.
 - c. Shorting type terminal blocks shall be provided for each current transformer. The terminal blocks shall be GE, Marathon, or equal. A lead shall be installed and terminated for each ratio of the multi-ratio current transformers.
 - d. Terminal blocks and terminations for each gas pressure relay.
 - e. Terminal blocks and terminations for all wires associated with electrical interlocking schemes.
 - f. Relays associated with electrical interlocking schemes. All auxiliary relays shall have covers to prevent operation due to inadvertent bumping.
 - g. Terminal blocks for alarm circuits and miscellaneous remote control functions.
 - h. Terminal blocks for all spare contacts of circuit breaker, disconnect, and grounding switches.
 - i. Trip coil monitoring relay for each trip coil.
 - j. Provide two additional 12 point terminal blocks, per cubicle, for owner use.
3. Each control cabinet shall be equipped with a mimic diagram of sufficient size and color (Owner provided) contrast to be plainly visible to an operator.

B. Mimic Diagram

- 1. Mimic diagrams shall show circuit breakers, three-position disconnect and grounding switches, cable grounding switches, and busbar connections at cubicles and control panels, along with color indications at both places.
- 2. Symbols on the mimic diagrams shall be in accordance with ANSI Y 14.15 and ANSI Y 32.2.

C. Local Control Panel

- 1. The local control panel shall be completely wired and installed on the front of each switchgear panel as an integral part and tested as a complete system.
- 2. External control cables shall enter through the top/bottom of the panel. Manufacturer shall provide the necessary cut outs and space to allow cable access.
- 3. Wiring shall conform to NEC requirements. Wiring shall be neatly arranged and secured to the panel or supported by suitable brackets as required. Splicing of wires shall not be acceptable.

4. All field wiring, except as noted, shall terminate on terminal blocks with numbered strips to identify each terminal or fuse block. All required jumpers shall be located opposite the field terminations on the terminal block.
5. Each terminal screw shall carry no more than two wires.
6. Terminal blocks shall be arranged in a series of rows. Panel wiring and field wiring shall be segregated from one another by the row of terminal blocks. No devices, or other material, shall obstruct access to the terminal blocks for connections of terminals or for installation of control cables.
7. Wiring shall be terminated by insulated ring tongue terminals with brazed barrels. Crimping shall be done with a ratchet-type crimping tool. Wiring shall be marked at both ends (i.e. at the device and at the terminal block or other device). Designations to be approved by Owner.

2.26 GROUNDING PROVISIONS

- A. Grounding shall be provided to ground both the outgoing circuit and the bus bars, but not both simultaneously, by closing the bus bar ground switch, then the circuit breaker and then the cable ground switch. The grounding function shall form part of the integral design of the equipment and shall offer complete safety interlocking to prevent accidental mal-operation. It shall not be possible to select an integral grounding position unless the circuit breaker is in the open position. Locking facilities shall be provided for the grounding devices.

2.27 DESIGN TESTS

- A. Short Circuit Type Tests:
 1. To support the short circuit ratings assigned to the circuit breaker offered, the manufacturer shall submit with the proposal a certificate of short circuit rating or a complete short circuit test report (including oscillographic and photographic records, etc.) In addition, the manufacturer may also submit, if available, a type test certificate issued by an International Short Circuit Testing Authority such as PEHLA, ASTA, or KEMA.
 2. The Certificate or report shall cover the No-Load Operations and Basic Short Circuit Test Duties (including Critical Tests where necessary) and Short Time Current Tests as specified in IEC 56.4 and this Technical Specification.
- B. Test for Assembly, Mechanical Endurance, Temperature Rise:
 1. As part of the type test, a complete switchgear panel shall have been tested for mechanical endurance of the circuit breaker (equipped with closing device) consisting of 1000 operations, followed by a test for temperature rise of the complete switching equipment. A temperature rise test shall also have been conducted on the busbars to prove compliance with design requirements.
- C. Impulse Voltage Tests:

1. A typical GIS panel shall have been subjected to an impulse voltage test. The test voltage shall be a full impulse voltage wave conforming with the requirements set out in the relevant IEC Standards.

2.28 FACTORY TESTS

- A. The switchgear shall be fully assembled before testing.
- B. The GIS and accessories furnished under this specification shall be fully tested and documented by certified test reports, in accordance with IEC 62271-200.
- C. The low voltage control panel shall be tested in accordance with the applicable ANSI standards.
- D. Production Tests:
 1. The following production tests shall be conducted for the primary portion of the switchgear, as a minimum, in accordance with IEC 62271-200:
 - a. Dielectric test on the main circuit
 - b. Partial discharge test
 - c. Test on auxiliary and control circuits
 - d. Measurement of resistance of the main circuit
 - e. Mechanical operation tests
 - f. Electrical function test / Design and visual checks
 - g. Tightness test
 - h. Pressure test on gas filled compartments
 - i. Measurement of gas condition after filling
 2. The following production tests shall be conducted for the secondary portion of the switchgear, as a minimum, in accordance with IEEE C37.20:
 - a. CT ratio and polarity test
 - b. PT ratio, polarity and phase rotation
 - c. Control wiring insulation power frequency
 - d. Instruments Polarity Verification
 - e. Operation Testing (circuit breaker, disconnects, interlocks and transfer circuits)
- E. All test terminals shall be easily accessible without having to dismantle any part of the switchgear.

2.29 FACTORY ACCEPTANCE TEST

- A. The Manufacturers price shall include all costs for a factory acceptance test, which is carried out as a witness test prior to shipping of the complete GIS assembly, including the low voltage control compartment, to its final destination.
- B. Provide Factory Acceptance Testing for up to four (4) VIWAPA employees and the Engineer of Record. Travel expenses and lodging are by VIWAPA. Manufacturer shall provide 15 working days' notice of all tests.

- C. The manufacturer shall provide a sample of a factory acceptance test program with the proposal. The bidder shall provide detailed specifications of the testing and where it shall take place. Provide this information with the proposal.

PART 3 - EXECUTION

3.1 GENERAL

- A. In addition to the requirements specified herein, execution shall be in accordance with the requirements of Specification Section 260800 and drawings.
- B. Examine equipment exterior and interior prior to installation. Report any damage and do not install any equipment that is structurally, moisture, or mildew damaged.
- C. Verification of Conditions: Examine areas and conditions under which the work is to be installed, and notify the Contractor in writing, with a copy to the Owner and the Engineer, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.
 - 1. Verify that required utilities are available, in proper location, and ready for use.
- D. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.
- E. Install equipment in accordance with reviewed product data, final shop drawings, manufacturer's written instructions and recommendations, and as indicated on the Drawings.
- F. Functional testing, commissioning, and first parameter adjusting shall be carried out by a factory trained manufacturer's representative field service engineer. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment. Report to the Engineer any discrepancies or issues with the installation.
- G. Provide final protection and maintain conditions in a manner acceptable to the manufacturer that shall help ensure that the equipment is without damage at time of Substantial Completion.
- H. Pre-Installation Conference: Prior to commencing the installation, meet at the Project site to review the material selections, installation procedures, and coordination with other trades. Pre-installation conference shall include, but shall not be limited to, the Contractor, the Installer, manufacturer's representatives, and any trade that requires coordination with the work. Date and time of the pre-installation conference shall be acceptable to the Owner and the Engineer.
- I. The switchgear installer shall use factory trained and certified service personnel to assist in the installation of the gas insulated switchgear and during the commissioning process.

- J. Manufacturer shall assign a single Project Manager to manage and coordinate all commercial and technical aspects of the project. Project Manager shall submit periodic progress reports and maintain the master project schedule.

3.2 INSTALLATION

- A. Installation and testing shall be performed with the assistance and supervision of factory trained and certified field service personnel.
- B. Installation of the switchgear units, devices, and materials on the building site, including, but not limited to, inserting the switching unit into the GIS Room, shall be performed by a certified and trained service personnel. This shall include, but shall not be limited to, the following:
 - 1. Positioning and adjustment of the switching unit onto an existing base frame.
 - 2. Connection of the switchgear to an existing grounding system.
 - 3. Performance of an on-site rated alternating voltage test for the bus bar per section.
- C. Install cables, as provided by the switchgear manufacturer, to connect the primary surge arresters.
- D. Bending of high voltage cables shall be avoided or minimized. Necessary bends shall meet at least the minimum radii specified by the cable manufacturer
- E. Perform low frequency withstand (Hi-Pot) tests according to ANSI/IEEE C37.20.3, Paragraph 9.2.

3.3 FIELD QUALITY CONTROL

- A. Functional testing, commissioning, and first parameter adjusting shall be carried out by a factory-trained manufacturer's field service representative. This manufacturer's field service technician shall provide all material, equipment, labor and technical supervision to perform inspection, testing and adjustments to ensure equipment is installed, adjusted, and tested in accordance with the manufacturer's recommendations and is ready for operation. The manufacturer's field service technician shall replace damaged or malfunctioning equipment and report to the Engineer any discrepancies or issues with the installation.
- B. The manufacturer's representative shall, upon satisfactory completion of inspection and testing, attach a label to all serviced devices indicating the date serviced and testing company responsible.

3.4 FIELD TESTING AND COMMISSIONING

- A. Operational Readiness Testing
 - 1. The Contractor shall inspect and test furnished equipment and associated systems for conformance to the contract documents, including equipment manufacture's recommendations, and readiness for operation. The test shall include the following as a minimum:
 - a. Visually inspect for physical damage and proper installation

- b. Perform tests in accordance with manufacturer's instructions
 - c. Perform tests to ensure compliance with Contract Documents
 - d. Perform tests that equipment is ready for operation
 - e. Touch-up paint all chips and scratches with manufacturer-supplied paint and transfer remaining paint to Owner
2. Contractor shall submit an operational readiness test report documenting all test results, including all assumptions, conditions, allowances and corrections made during the test. The report shall provide a listing of all modifications and adjustments made onsite to include any settings / parameters not identified as factory defaults within the equipment's O&M documentation. The test report shall include a signed statement from the Contractor, installer(s) and the factory-trained manufacturer's representative(s) certifying that the furnished equipment and associated system have been installed, configured, and tested in accordance with the manufacturer's recommendations, completely conforms to the requirements of the Contract Documents and is ready for operation.

B. Functional Demonstration Testing

1. Prior to scheduling functional demonstration testing the Contractor shall submit a signed statement from the Contractor, installer(s) and the factory-trained manufacturer's representative(s) certifying that the furnished equipment and associated system have been installed, configured, and tested in accordance with the manufacturer's recommendations, completely conforms to the requirements of the Contract Documents and is ready for operation.
2. The Contractor shall completely demonstrate the functionality and performance of the equipment and associated systems in the presence of Owner and Engineer, observing and documenting complete compliance with the Contract Documents.
3. The Contractor shall submit a written report documenting successful completion of functional demonstrating testing including all assumptions, conditions, allowances and corrections made during the test.

3.5 TRAINING

- A. O&M Training: Onsite training specific to the equipment furnished shall be provided to the Owner's staff by a factory trained manufacturer's representative. Training duration shall be sufficiently adequate to cover the operation and maintenance of the equipment and shall consist of not less than 2 repeated session(s) with 4 hours of onsite classroom and hands-on instruction for a minimum of 4 attendees per session.
1. The instructor shall provide sufficient time and detail in each session to cover the following as a minimum:
 - a. Theory of operation
 - b. Major components of equipment
 - c. Operation of equipment
 - d. Configurations of equipment
 - e. Maintenance, troubleshooting and repair

- f. Replacement of component level parts
- 2. The submitted O&M manuals shall be used for training. Manuals and documentation shall be provided to each participant for training.

END OF SECTION 26 13 23

CONTROL CABLE

PART 1 – GENERAL

- A. General. This specification covers furnishing shielded and unshielded substation control cable.
- B. Codes & Standards. All materials furnished under these specifications shall conform to applicable requirements of ICEA, IEEE, and ASTM standards. All materials shall be in accordance with the applicable requirements of the Federal “Occupational Safety and Health Standards.”
- C. Application. These control cables shall be installed in ventilated cable trays, underground ducts, and/or raceway, in wet and/or dry locations.
- D. Conductor. Conductor shall be 7 strand, concentric-lay, copper, strand class B, normal operating temperature 90° C.
- E. Insulation. Flame retardant ethylene propylene rubber or flame retardant XLPE not less than 30 mils average thickness, 27 mils minimum thickness for sizes #18 to #9 awg, with a minimum tensile strength of 2000 psi, and meets the specified voltage and flame tests.
- F. Shield. (Shielded Cable Only) Cable assembly: Longitudinal corrugated copper tape, 5 mils nominal thickness. The tape shall have 12 to 14 corrugations per inch, the depth of corrugations on the finished cable shall be 25 to 30 mils, and the tape shall have a minimum overlap of 1/8 inch.
- G. Jacket. (Shielded Cable Only) Thermoplastic chlorinated polyethylene compound. The minimum thickness over the peaks of the corrugation shall be not less than 80 percent of the values specified in these specifications.
- H. Jacket. (Unshielded Cable Only) Thermoplastic Chlorinated polyethylene compound. The minimum thickness shall meet the requirements of these specifications.
- I. Conductor Identification. ICEA S-73-532, Method 1, colored compounds with tracers, Table E-2 for all protection and control cabling, Table E-1 for 2/C DC power cables.
- J. Assembly. The conductors shall be cabled together with a flame retardant filler, as necessary, to make the finished cable round.
- K. Factory Tests
 - 1. Preliminary Test Tank Test
All insulated single conductors, prior to cabling, shall be tested and pass the following AC test after not less than 6 hours immersion in water and while still immersed.
 - a. Test method per ICEA T-27-581
AC Withstand, 5 minutes Table I
Final Test (Dry Test)
 - 2. Completed cable assemblies shall pass the following:
 - a. Conductor DC Resistance, max. Per ICEA S 95 658 or S-73-532, Sec 2.3
AC Withstand per ICEA T-27-581, 5 min. Table I

Insulation Resistance, min., 15.6°C

20,000 Megohms

3. Construction of the completed cable shall be checked and meet the requirements of this specification.
 4. Each conductor and the finished cables shall also meet the flame test requirement per IEEE 383 and ICEA 1202 using a gas-burner flame source. In lieu of the flame test, the manufacturer may submit previous prototype test results. Four copies of certified test reports shall be submitted for record purposes.
- L. Cable Details. (Shielded – All Cables Unless Otherwise Noted) See drawings for size/quantity
Cable Details. (Unshielded – DC Cables Only) See drawings for size/quantity
- M. The cable jacket shall be durably marked at intervals not exceeding 24 inches with the following information.
- a. Manufacturer's name
 - b. Type of cable
 - c. Conductor size
 - d. Conductor material
 - e. Rated voltage
 - f. Year of manufacture
- N. Packaging. Cable ends, whether exposed or concealed shall be sealed with heat or cold shrinkable caps.
- O. Guarantee. The cable covered in these specifications shall be guaranteed to be free from defects in workmanship for a period of two years from date of shipment by the manufacturer.

END OF SECTION – CONTROL CABLE

RELAY PANELS

PART 1 – GENERAL

1.1 SCOPE

- A. This specification document covers the following equipment and materials.
 - 1. Relay Panels
 - 2. Loose relay components
- B. All equipment and systems furnished shall be in accordance with these specifications, and as shown on the documentation included with these specifications. The equipment shall be installed in the Control Room in the locations indicated on the Contract Drawings.
- C. Where a specific manufacturers name is listed an equal substitute may be used.

1.2 SERVICE CONDITIONS

- A. All equipment shall be capable of satisfactory operation in a tropical, highly corrosive environment with the following characteristics.

1. Elevation	Less than 100 feet
2. Maximum ambient temperature	100 Degrees F
3. Minimum ambient temperature	50 Degrees F
4. Humidity (average)	90%
- B. Seismic: ASCE 7; Site Class D, 0.2 second spectral response acceleration of 123% g, Importance factor 1.5, Site Class “D”.

1.3 CODES AND STANDARDS

All equipment furnished shall be in accordance with applicable standards of IEEE, NEMA, ANSI C37.20, and applicable requirements of the Federal “Occupational Safety and Health Standards”.

1.4 EQUIPMENT REQUIRED

Equipment, materials, and accessories shall be furnished mounted, and connected as indicated on the drawings and as described in the Relay Panel Bill of Materials included with these specifications.

PART 2 – RACK MOUNT RELAY PANEL

2.1 GENERAL

- A. The relay panel shall be an assembly of removable modular panel sections fabricated from not less than 11 USS gauge leveled steel sheets and formed steel members reinforced as required to form a rigid self-supporting structure. The structure shall be enclosed on the front, rear, top, and both sides when fully assembled.
- B. Mounting plates and brackets for mounting and wiring auxiliary devices and terminal blocks shall be arranged as shown on the drawings. Mounting brackets shall be submitted to the Engineer for approval.
- C. Panel space not used by equipment shall have blank plates installed and shall remain clear for addition of future equipment.
- D. Protective relays and pertinent auxiliary devices shall be mounted on the rack mount section of the panel. Rack mount sections of the panel shall accommodate standard 19-inch EIA rack mount equipment. Panel cutouts, mounting studs, and support brackets shall be accurately located. Final arrangement shall be submitted to the Engineer for approval.
- E. The relay panel dimensions shall be as indicated on the drawings. The panel shall be designed to have both front and rear access doors. The front door shall have a Plexiglas area large enough to view the front of all relays mounted on the 19 inch rack. The panel shall also have removable access panels at the top, with the bottom of the panel open, and shall not have permanent bottom braces.
- F. The relay panel shall be equipped with removable lifting eyes.

2.2 RACEWAY

- A. An adequate raceway system shall be provided for all wiring on each side of the panel.
- B. A complete modular system of separate vertical wiring raceways shall be provided for all factory and field wiring. This shall include vertical raceways along both sides of the panel. The raceway shall consist of a formed sheet metal assembly integral to the panel and of similar construction and shall include bolt-on removable covers. Conveniently located

openings between factory and field wiring raceway shall be provided to facilitate wiring. The openings shall have rubber grommets installed to protect the wiring.

- C. The raceway for internal wiring shall be sized so that fill does not exceed 30 percent. Vertical raceway for field wiring shall be not less than twice the size of the raceway provided for factory wiring or shall have a minimum cross-sectional area of approximately 30 square inches whichever is larger.
- D. Vertical raceways for field wiring shall be accessible to cables entering from either the top or the bottom of the switchboard.
- E. Horizontal raceway if necessary shall be plastic wiring ducts with covers as manufactured by Panduit Corporation or equal.

2.3 CONTROL POWER

Each panel mounted device requiring an AC or a DC supply, as indicated in the elementary and schematic diagrams, shall have in its supply circuit a panel mounted fuse. Fuse blocks shall be of the modular type with a bakelite frame. Blocks shall be class H, 2-pole, type F30A2S as manufactured by Marathon or equal. Fuses shall be Bussmann NON or equal. Ampere rating of the fuses shall be in accordance with the schematics and elementary diagrams.

2.4 WIRING

- A. All internal wiring within the relay panel shall be neatly and carefully installed and tested. Non insulated ring type terminal connectors shall be used on all terminals.
- B. The relay panel wiring shall consist of 14AWG or larger stranded copper conductor with flame-retardant cross-linked polyethylene insulation rated 600 volts. The wiring shall be General Electric Vulkene type SIS, SI 57275, or equal.
- C. Each terminal block, terminal, relay, fuse block, and other auxiliary devices shall be permanently labeled to coincide with the identification indicated on the drawings. All terminals provided for termination of external circuits shall be identified by inscribing circuit designations as shown on the wiring diagrams furnished, on the terminal block marking strip.

2.5 SURGE PROTECTION

- A. All fusing, switches, and surge protection shall be furnished as required to protect the furnished equipment.
- B. All system power supplies shall provide isolation between the equipment furnished under these specifications and the Owner's power source. All equipment furnished shall meet all surge withstand capability (SWC) tests, as defined in IEEE C37.90.1-1989 without damage to the equipment or misoperation.

2.6 TERMINAL BLOCKS

Terminal blocks shall be provided with white marking strips. Terminal blocks shall be rated 600 volts minimum. Terminal blocks shall be General Electric EB-25 or equal. Each relay panel shall be furnished with sixteen (16), 12-point, terminal blocks, unless noted otherwise.

2.7 GROUND BUS

- A. A continuous 1/4 inch by 1-inch cross-section bare copper horizontal ground bus, with compression or clamp type connectors at each end shall be provided. The end connectors for connection to the station ground with 4AWG stranded copper ground cable shall be Burndy YA-L or VVA or equal. The bus shall be furnished with tapped holes. All panel equipment requiring grounding shall be connected to this bus.
- B. A continuous 1/4 inch by 1/2 inch cross-section bare copper ground bus of similar construction of the bus described above, shall be installed to extend vertically the entire length of the terminal blocks on each side panel between the terminal blocks and the cable entrance opening. The ground bus shall be furnished with tapped holes. The busses shall be connected to the horizontal ground bus using 4AWG stranded copper ground cable. This bus shall be utilized to ground the shield of all shielded control cable.

2.8 NAMEPLATE

Nameplates shall be furnished as indicated on the drawings. Nameplates shall be made of white phenolic engraving stock with black core. Nameplates shall be attached to the panel with stainless steel panhead screws. A nameplate engraving list is indicated on the Contract Drawings.

2.9 PAINT SPECIFICATIONS

- A. The relay panel shall be prepared for painting using the manufacturers standard procedures. Finished panel surfaces shall be free of waves, bellies, and other imperfections.
- B. The relay panels shall be finish painted over prime paint. Two coats or more of high gloss alkyd enamel shall be applied to a minimum thickness of 1.5 mils per coat. The manufacturer shall use their standard paint system. Exterior panel surfaces shall be finished with ANSI 61 gray enamel. Interior surfaces shall be finished with gloss white enamel. Paint films which show sags, checks, blisters, teardrops, or fat edges will not be acceptable.
- C. The manufacturer shall include touchup paint when shipping the panel. The paint shall be of the same type and color as the applied finish paint.

PART 3 – DOCUMENTATION

3.1 EQUIPMENT DRAWINGS

- A. A complete set of drawings shall be provided by the manufacturer for the equipment furnished under these specifications. Drawings shall indicate the kind, size, arrangement, weights, breakdown for shipment, and operation of component materials and devices; the external connections, anchorages, and supports required, the dimensions needed for installation, and the information specifically requested in these specifications.
- B. All drawings shall be prepared using AutoCAD. The drawing file format shall be a “dwg” file. The drawing file structure shall be compatible with AutoCAD version 2014 or higher. All text fonts used by the manufacturer in creating the AutoCAD drawings shall be furnished. Drawing files shall be vector editable. Rasterized image files are not acceptable.

3.2 DESIGN DRAWINGS

- A. The following are included herein:
 - 1. Relay Panel Elevation
 - 2. One-line diagram
 - 3. AC Elementary Diagrams for all relay schemes
 - 4. DC Elementary Diagrams for all relay schemes
 - 5. DC Elementary Diagram for DPAC
 - 6. Relay Panel Wiring Diagram for each relay panel

3.3 MANUFACTURERS DRAWINGS

- A. The following drawings shall be provided by the manufacturer, to cover details and specifics of the equipment being furnished.
 - 1. Panel arrangement drawings
 - 2. Panel assembly drawings
 - 3. Bill of materials

3.4 DRAWING SUBMITTAL

The manufacturer shall submit drawings for approval by the Engineer. After the drawing approval process is successfully completed, the manufacturer shall provide final drawings that consist of AutoCAD Dwg drawing files. Files shall be submitted via email or on a share file, adequately labeled as to its contents.

3.5 GUARANTEE

The equipment specified shall be guaranteed to be free from defects in performance and workmanship for a period of one year beginning with the date of energization of the equipment.

PART 4 – BILL OF MATERIALS

4.1 FOR EACH RELAY PANEL (TOTAL OF TWO (2) REQUIRED).

- A. One (1) self-standing steel cabinet, approximately 93.31” high, 30” wide, and 30” deep; 19” rack mount front; with front and rear access doors; ANSI 61 Gray finish exterior, and white finish interior; with components mounted, wired, and tested.
- B. One (1) convenience receptacle, wired to AC fuse and terminal blocks.
- C. One (1) fluorescent light and light switch wired to AC fuse and terminal blocks.
- D. Sixteen (16), 12-point terminal blocks.
- E. Fuse blocks as per drawings.
- F. Relays, meters, control switches, test blocks, test switches, lockouts, etc. as per drawings.
- G. Necessary equipment mounting hardware including fasteners, grounding bus, wiring, and cable support straps.

H. Material, terminal lugs for internal wiring and external cables, nameplates, etc.

I. Engraved nameplate.

PART 5 – INSTALLATION

5.1 Bolt relay panels to floor in accordance with manufacturer's instructions.

5.2 Provide 20 amp, 125 VAC power to each relay panel terminal at AC fuse.

5.3 Provide 20 amp, 2 pole, 125 VDC circuits to each relay panel as specified on drawings.

END OF SECTION