

## 1 PART 1 – GENERAL

### 1.1 SCOPE

- 1.1.1 The Manufacturer shall supply, delivery and supervision of installation, testing and commissioning of a Dry type Transformers as per the specs below, requirements and standards which includes:
- .1 Design, manufacturing, factory testing, delivery on site.
  - .2 Prepare Shop drawings for engineer review as per below specifications.
  - .3 Supervision of installation, testing and commissioning and provisions of directions to installation testing and commissioning contractor.
  - .4 Field testing and commissioning by manufacturer's service group in front of the Owner Representative, provide separate cost line item for testing and commissioning and provide what will be main contractor scope of work required as a support for manufacturer service team during testing and commissioning.
- 1.1.2 Two dry type transformers as per below and as indicated on the drawings.
- .1 Two 13.8KV-4.16KV, 3,750KVA base capacity and 4,980KVA with forced cooling fans, general purpose high efficiency transformer to CSA 802-02, non-drip proof.
- 1.1.3 All cables entry shall be from the top of the transformers.
- 1.1.4 The transformer manufacturer is responsible for the design, fabrication, assembling the enclosure of the dry type TR's on the site, test, and transportation on site (for off-loading and erection by the installation contractor), all in coordination with the REPI representative.
- 1.1.5 The TR manufacture shall provide an adder optional in the quote to supply and deliver of the transformers to site with core and coil only and the TR's manufacturer service team to assemble the enclosure around the core and coil inside the electrical room at site. This shall be optional in the transformer manufacturer quote.

### 1.2 REFERENCES – LATEST EDITION

- 1.2.1 Canadian Standards Association (CSA International):
- .1 CSA C22.2, Canadian Electrical Code Part 1, Safety Standards for Electrical Installations, BC Bulletins latest edition, and regulations of the local inspection authority.
  - .2 CSA C9, Dry-Type Transformers.
  - .3 CSA C9.1 Guide for Loading Dry Type Distribution and Power Transformers.
  - .4 CSA C22.2 No. 47 Air Cooled Transformers (Dry-Type)
  - .5 CSA 802.2-07 Energy Efficient Dry type Transformers.
  - .6 CSA 802.3, Maximum Losses for Power Transformers
- 1.2.2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
- .1 EEMAC GL1-3-1988, Transformer and Reactor Bushings.
- 1.2.3 National Electrical Manufacturers Association (NEMA)

- 1.2.4 American National Standards Institute (ANSI)
  - .1 ANSI Standard C89.2 Dry Type Transformers for General Applications.
  - .2 Applicable Sections of ANSI Standard C57 including but not limited to: C57-12.01, C57-12.51, C57-12.55, C57-12.91, C57-12.94, C57-12.96, C57-12.98
- 1.2.5 Department of Energy (DOE)
  - .1 DOE 10 CFR Part 431 Efficiency Standards, Canadian Energy Efficiency Regulations SOR/94-651.

### **1.3 SUBMITTALS WITH PROPOSALS**

- 1.3.1 The vendor's proposal shall contain a technical proposal, commercial proposal, and exceptions or clarifications section.
- 1.3.2 The technical proposal shall contain as a minimum:
  - .1 Data sheets.
  - .2 Base plan, outline and assembly arrangement drawings.
- 1.3.3 The exceptions and clarifications section shall contain as a minimum:
  - .1 List of deviations from this specification. Failure to note deviations will imply conformance with this specification as written.
  - .2 The exceptions and clarifications section shall contain list of deviations from the owner's terms and conditions

### **1.4 PRODUCT DELIVERY REQUIREMENTS**

- 1.4.1 The transformers shall be installed at new RPEI 16N Central Energy Centre.
- 1.4.2 The intent is to have the transformers core and coil fully assembled and wired at the supplier's facility, and the sections would then be prepared for delivery. However, the Manufacturer/Vendor is responsible for evaluating and confirming the need for any special shipping preparation required to facilitate the delivery of the unit to the plant floor. Access is through plant basement ramp.
- 1.4.3 Due to timing constrains, the transformers may be required to be stored outdoors before final installation in a heated enclosed plant space. The manufacturer shall provide proper protections / wrapping to prevent damage during shipping and site storage.
- 1.4.4 Deliver, store, protect, and handle products in accordance with recommended practices listed in manufacturer's Installation and Maintenance Manuals.
- 1.4.5 Transformers shall be provided with adequate lifting means and shall be able to be rolled or moved into installation position and bolted directly to housekeeping pad without using floor sills.
- 1.4.6 Ensure no concealed damage during delivery and shipping, and arrange for replacement of the damaged items at earliest possible with no impact on the project schedule.
- 1.4.7 Coordinate with the owner, provide clear instruction regarding the storage requirements and verify that the storage meets the requirements.

- 1.4.8 All necessary field connections, wire jumpers, bolts, nuts, etc., shall be suitably packed and identified to facilitate field reassembly of the switchgear if required.
- 1.4.9 Transformers shall be delivered to site no later than the date determined by the owner under any circumstances. It is responsibility of the switchgear supplier to make any effort (through providing complete information and compliance to the contract document) during shop drawing review process to keep the review process short .

## **1.5 SHOP DRAWINGS SUBMITTAL - GENERAL**

- 1.5.1 Drawing submittals shall include, but not necessarily be limited to:
- .1 Catalogue Drawings include reprints of catalogue drawings of proprietary articles of standard fabrication and manufacture for the work.
  - .2 Shop Drawings include dimensioned line drawings and related specifications, information and literature for custom fabricated articles and equipment.
- 1.5.2 Submit PDF copies of shop drawings for review.
- 1.5.3 Submit all drawings in SI metric units.
- 1.5.4 Two stamped shop drawings will be returned to the manufacturer after review. None of the catalogue drawings will be returned to the Contractor if the equipment depicted conforms to the specifications.
- 1.5.5 Submit shop drawings in 5 working days after receipt of order.
- 1.5.6 Recognize extensive engineering review time, if the information provided are not complete.
- 1.5.7 Contract Administrator will stamp each submission as “ REVIEWED, REVIEWED AS NOTED, REVISE AND RESUBMIT or NOT REVIEWED”. Do not change shop drawings after they have been reviewed and stamped.
- 1.5.8 Identify changes on re-submissions and include revision dates.
- 1.5.9 Payment will not be authorized for equipment and materials delivered to the site of the works before corresponding shop drawings have been reviewed and accepted.
- 1.5.10 If the Contract Administrator requests details or items on shop drawings which the manufacturer believes require extra payment, make any claims promptly and receive acceptance of extra work, before proceeding with fabrication. This will not result any change in schedule.
- 1.5.11 Final review of specific equipment and materials shop drawings is subject to witnessing or review by the Contract Administrator, of testing, start-up, commissioning and operation of the equipment for the periods specified, or performance of the material(s) and after all guarantees have been fulfilled as specified.
- 1.5.12 The Contract Administrator will review the shop drawings or Contractor’s design only for conformance with the contract document design concept and general arrangement. The Contract Administrator’s review does not relieve the Contractor from compliance with requirements of the Contract Documents nor relieve him of responsibility for and the consequences arising out of errors in the shop drawings or Contractor’s design.

- 1.5.13 Fabrication, erection, installation or commissioning may require modifications to equipment or systems to conform with the design intent. Provide record "as built" shop drawings together with comprehensive operations and maintenance manuals.
- 1.5.14 No claims will be allowed for monetary compensation or extension of the schedule, arising from delays caused through submission by the manufacturer, which are incomplete, lack sufficient information and which for those inadequacies, or for any other reason, are returned to the manufacturer for revision and re-submission, thus requiring repeated review by the Contract Administrator.
- 1.5.15 Keep one copy of each stamped, reviewed shop drawing at the site of the work for reference during construction work progress.

## 1.6 SHOP DRAWINGS SUBMITTALS

- 1.6.1 The following information shall be submitted:
- .1 Data sheet
  - .2 Base plan, outline and assembly arrangement drawings
  - .3 Dimensioned drawing showing base plan, enclosure, mounting devices, terminals, taps, internal and external component layout. Layout drawings shall include physical size, anchor bolt and foundation details, terminal locations, nameplate, and any other pertinent information required for proper installation and wiring of the transformer. Drawings shall show the available physical space at power and control terminations for the training/support of the conductors. Drawings shall be coordinated with the drawings for the 4.16KV switchgear, so that the double ended transformer 4.16KV switchgear is captured as an assembly.
  - .4 Lifting, jacking, hauling, rolling and skidding data.
  - .5 Required services and connection points.
  - .6 Core and coil assembly drawings
  - .7 Schematic and wiring diagrams, showing all interconnections and their function when wired into the electrical system.
  - .8 Nameplate, connection and voltage phasor diagrams.
  - .9 Centres of gravity.
  - .10 Details of ancillary devices.
  - .11 Technical data:
    - i. kVA rating.
    - ii. Primary and secondary voltages.
    - iii. Frequency.
    - iv. Three phase.
    - v. Polarity or angular displacement.
    - vi. Full load efficiency.
    - vii. Regulation at unity pf.
    - viii. BIL.
    - ix. Insulation type.
    - x. Sound rating.

- 1.6.2 Prior to delivery, submit Operating and Maintenance Manuals, including but not limited to the following:
- .1 Installation, operation and maintenance instructions.
  - .2 Parts list with details of local service and supply organization.
  - .3 Certified final test results.
  - .4 Final record drawings.
  - .5 Final data sheets.

### **1.7 CONSTRUCTION DRAWINGS SUBMITTAL:**

- 1.7.1 Prior to delivery, submit the following information (6copies)
- .1 Final as-built drawings and information for items listed above.
  - .2 Certified production test reports
  - .3 Certified efficiency (load loss/ no load loss) test report.
  - .4 Final datasheet
  - .5 Installation instructions.

### **1.8 OPERATION AND MAINTENANCE MANUALS**

- 1.8.1 Equipment operation and maintenance manuals shall be provided with the transformer shipped and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component (PDF copies)
- 1.8.2 Operation and maintenance manuals to include illustrated parts list complete with catalogue numbers, copy of factory test / commissioning reports, recommended maintenance instructions and schedules, as well as the spare parts list recommended for two years of operation.

### **1.9 QUALITY ASSURANCE**

- 1.9.1 Subject transformer to production tests as specified by CSA C9. Perform additional tests as per manufacturer's standards.
- 1.9.2 All transformers shall be certified to CAN/CSA C22.2 No. 47. The certification shall appear on the transformer's nameplate.

### **1.10 COORDINATION**

- 1.10.1 Be responsible and coordinate with Installing Contractor and ensure that there is no delay caused by such works.
- 1.10.2 Notify Installing Contractor of all openings, inserts, anchors, sleeves, hangers, foundations, etc. necessary for electrical work, and be responsible so that these are provided and correctly installed at the proper time.

## 2 PART 2 - PRODUCTS

### 2.1 MATERIALS

- 2.1.1 Dry-type transformers: to CSA C9.
- 2.1.2 Bushings: to EEMAC GL1-3, NEMA.

### 2.2 13.8KV-4.16KV TRANSFORMER CHARACTERISTICS

- 2.2.1 Type: ANN/ANF.
- 2.2.2 Rating: 3750 base capacity/4980 KVA with forced cooling fans, 3 phase delta/wye, solidly grounded neutral, 60 Hz.
- 2.2.3 Location: I (indoor)
- 2.2.4 Design temperature: 40°C.
- 2.2.5 Insulation system class H suitable for 220°C.
- 2.2.6 The maximum temperature rise shall not exceed 80°C above 40°C (room temperature) operating at full nameplate rating and on a continuous basis. Transformers shall be capable of carrying a 15% continuous overload without exceeding 150°C rise in a 0°C ambient.
- 2.2.7 Hot spot at rated kVA: 65°C.
- 2.2.8 Impedance: 6.5 minimum of self-cooled rating, on principal tap within CSA tolerance.
- 2.2.9 Primary winding: voltage rated 13.8KV, Delta, BIL 95kV; copper or aluminum, VPI, the transformer shall be able to operate at voltage 13.8KV (line to line voltage) at the primary side.
- 2.2.10 Secondary winding: 4.16KV, Star, BIL 60kV, four wire with neutral effectively grounded; copper or aluminum, VPI.
- 2.2.11 Winding temperature: 220°C.
- 2.2.12 Connections:
  - .1 Primary: Top entry cables, size 1 x 3C #500MCM, 25KV rated,133%,shielded, HVTeck + GND
  - .2 Secondary: Top entry cables size 2 sets of 3\*1C\*750MCM, MV-90, shielded,133% + GND
- 2.2.13 Enclosure type: EEMAC1/NEMA-1.
- 2.2.14 Overall height of the TR's shall **not exceed 2.8 mtr** including the enclosure and the ventilation fans, width and depth shall not exceed what shown in the drawings.
- 2.2.15 Colour: ASA 61 grey.
- 2.2.16 Efficiency
  - .1 99.1% minimum.
- 2.2.17 Manufacturer shall include guaranteed design data for transformer losses, as per CSA 802.3, Maximum Losses for Power Transformers.

- 2.2.18 Off-load tap changer terminal board accessible from rear, complete with four 2-1/2% full capacity high voltage taps, two (2) up and two (2) down and lockable enclosure door;
- 2.2.19 Primary and secondary terminators to suit primary and secondary connections;
- 2.2.20 Where connections are to bus duct include for proper expansion couplers and provisions to prevent vibration transmission from the transformer to the bus ducts. Coordinate proper orientation with bus duct manufacturer;
- 2.2.21 Sound rating: transformers shall not generate mean sound pressure levels greater than those specified in CSA-C9.
- 2.2.22 Overload:
  - .1 The transformer shall be designed for 100% loads and to satisfy the ANSI/IEEE requirements for overload capability.
  - .2 In addition to the winding capabilities, all affected transformer components must be capable of the specified overloading. This includes the effects of leakage flux field, brushing, cables, connectors, and any other items considered in Appendix B of CSA CAN3-C88-M.
- 2.2.23 Communication interference: the transformer shall operate without interference to radio/TV reception or telephone communications within the constraints of CSA C108.3.1-M.
- 2.2.24 Provide spring isolation type anti-vibration mountings between I-beam base and concrete floor pad, to isolate not less than 90% of disturbing vibrations;
- 2.2.25 Structural I-beam steel base assembly;

### **2.3 PERFORMANCE REQUIREMENTS FOR ALL TRANSFORMERS**

- 2.3.1 Temperature rise:
  - .1 The maximum temperature rise shall not exceed 80°C above 40°C (room temperature) operating at full nameplate rating and on a continuous basis.
- 2.3.2 Overload
  - .1 The transformer shall be designed for VFD loads (about 60%) and to satisfy ANSI/IEEE requirements.
  - .2 In addition to the winding capabilities, all affected transformer components must be capable of the specified overloading. This includes the effects of leakage flux field, brushing, cables, connectors, and any other items considered in Appendix B of CSA CAN3-C88-M.
- 2.3.3 Transformer losses: manufacturer shall include guaranteed design data for transformer losses.
- 2.3.4 Communication interference: the transformer shall operate without interference to radio/TV reception or telephone communications within the constraints of CSA C108.3.1-M.
- 2.3.5 The transformer shall be Vacuum Pressure Impregnated (VPI) type.
- 2.3.6 Sound level: not to exceed 65db.
- 2.3.7 Enclosure

- .1 Fabricated from sheet steel, 2.7mm minimum, rigid vibration free housing.
- .2 Enclosure rating: EEMAC1/NEMA-1
- .3 Enclosure not to exceed size indicated. Transformer enclosure and transformer core mounting may need to be custom designed to meet tight size limitations and requirements.
- .4 Bolted removable panels for access to tap connections, enclosed terminals fan brackets, fans, lightning arrestors and other accessories.
- .5 Lifting means: on enclosure and on transformer core/coil assembly.
- .6 Ground bus: tin plated copper running full length of enclosure, with connection pads on both ends and ground strap for grounding transformer.
- .7 Due to the on-site space limitations for equipment access, manufacturer to make provisions so that the enclosure can be removed and re-installed after the installation of the transformer in final location.

#### 2.3.8 Windings

- .1 Power connections and taps: locate at front of core and coil assembly.
- .2 Winding material: copper or aluminum uniformly insulated.
- .3 Provide winding temperature indication with two form "C" contact outputs: High Temperature Warning, High High Temperature Alarm/trip.
- .4 Primary and secondary windings shall be constructed using 220°C insulation rating.
- .5 The windings must not absorb moisture, and shall be suitable for both storage and operation in adverse environments, including prolonged storage in 100% humidity and temperature from -30°C to 40°C and shall be capable of immediately being switched on after such storage without pre-drying.

#### 2.3.9 Cores:

- .1 The transformers cores shall be constructed of high grade, non-aging silicone steel laminations, with high magnetic permeability and low hysteresis and eddy current losses.
- .2 Magnetic flux density is to be kept well below saturation point.
- .3 The core shall be cruciform in shape, with mitered joints to keep core losses, excitation current and noise level at a minimum.

#### 2.3.10 Termination facilities

- .1 Primary and secondary termination fittings: to carry maximum full load current, including allowance of overload capabilities.
- .2 Termination hardware: bolts, plates, flexible straps, lugs, bus and other material necessary for termination.
- .3 Cable connections: sufficient space for cable entry and installation of stress relief cones and termination fittings.
- .4 Cable supports: suitably sized.

#### 2.3.11 Control cabinet:



- .1 Control panel: locate in front of transformer enclosure.
- .2 Wiring: 600V, 14AWG minimum, stranded, copper with heat, moisture and flame resistant cross-linked polyethylene insulation.
- .3 Identification: Wieland type Z wire markers at both ends of wire and terminal blocks marked with associated wiring designations.
- .4 Terminal blocks: Modular, rated 25A minimum, 600V, with barriers separating voltage levels.
- .5 Control panel door: hinged, provisions for padlocking.
- .6 Circuit protection: individual, with suitably rated mounted case circuit breaker.
- .7 Ground bus: tin plated copper.

2.3.12 Forced air (FA) shall contain all necessary components and wiring, including fans, for automatically increasing the kVA rating by 33%. The (FA) package shall include an electronic temperature monitor and fan control unit. The package shall include a Transformer Temperature Controller that monitors up to three (3) ventilated Dry Type transformer windings and (1) ambient temperature. The controller's electronic components shall be conformally coated to prevent premature failure due to extreme environmental conditions. The controller shall operate relays by comparing the highest winding temperature to stored set point temperatures and display four (4) thermocouple inputs as well as the stored maximum temperature and its associated winding. The unit shall provide Fans, Alarm, and Trip output relays. Form C contacts shall be provided to trip the transformer off-line if any of the winding temperatures exceeds the trip setting. A test function shall be provided to: test the digital display and all of the LEDs; simulate over-temperature conditions; and check the internal temperature of the monitor.

- .1 A 4-20 mA analog signal shall be provided for remote indication or for use with SCADA systems. The controller shall contain a real time clock that will allow the following data to be stored: fan elapsed run time in hours, time stamped temperature trending, time stamped alarm log and time stamped trip log. The unit shall have optional Fan failure detection that can start a backup fan or send an alarm. Provide a front accessible USB port to program the settings and download the monitored data. shall include an electronic temperature monitor and fan control unit and serial communications module. The temperature monitor and fan control shall include a local digital readout, GREEN – power on, YELLOW – fan on, RED – high temperature indicating lights; audible high temperature alarm with alarm silence pushbutton; maximum temperature memory with read and reset switch; auto/manual fan control switch, system test switch; temperature sensing in all three low-voltage coils. Auxiliary alarm contact and means for remote control and temperature monitoring shall be provided. Control power shall be provided from a separate, external control power source.

2.3.13 Surface Preparation and Coating

- .1 Finish: prime and finish paint transformer and appurtenances to manufacturer's standard specifications, suitable for service indicated.
- .2 Enclosure interior surface finish: one prime and one finish coat minimum, matte white paint.

- .3 Exterior surface finish: one coat prime and two coats minimum of finish enamel.
  - .4 Touch-up paint: one litre of original paint material from transformer's manufacturer.
- 2.3.14 Nameplates and Warning Signs
- .1 Warning signs: engraved lamacoid with 13mm white letters on red background for fixing to high voltage and low voltage access panels. Indicate switching device to be opened to de-energize transformer.
  - .2 Nameplate: non-corroding, with details as specified by CSA C9.
  - .3 Fixing hardware: non-corroding screws or rivets.
- 2.3.15 Accessories
- .1 Winding temperature detector relay and sensing elements with two sets of SPDT contacts.
  - .2 Wiring and terminal box for protective devices.
  - .3 Digital type winding temperature indicator with alarm contacts sequence contacts 3 required.
  - .4 Fans for forced air cooling, 120V, 1 phase, 60Hz, with thermostat control with temperature indicator sequence contacts control.
  - .5 Grounding terminal: inside outside of enclosure.
- 2.3.16 Noise suppression:
- .1 Anti-vibration pads: factory installed, neoprene, mounted between core/coil assembly and bottom support members in enclosure to eliminate 95% minimum sound transmission.
  - .2 Stiffening members: on enclosure panels to eliminate diaphragm noise amplification.
  - .3 Sound level: to CSA C9, not to exceed 65db.
- 2.3.17 Provide Seismic tested equipment as follows:
- .1 The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the latest ON Building Code.

## **2.4 EQUIPMENT IDENTIFICATION**

- 2.4.1 Equipment labels: nameplate size 7.

## **3 PART 3 – EXECUTION**

### **3.1 SOURCE QUALITY CONTROL**

- 3.1.1 Testing shall be done in accordance with IEEE C57.12.91 and shall include, as minimum the following tests:

- .1 Ratio
  - .2 Polarity
  - .3 Phase rotation
  - .4 No-load loss
  - .5 Excitation current
  - .6 Impedance
  - .7 Load loss
  - .8 Applied potential
  - .9 Induced potential
  - .10 The transformer windings must be free of partial discharge up to at least 1.2 times the rated line-to-ground voltage. All coils shall be subjected to partial discharge test to verify its partial discharge.
  - .11 QC impulse test.
  - .12 Temperature test (typical data from previous unit is acceptable)
  - .13 Sound test (typical data from previous unit is acceptable).
- 3.1.2 Efficiency tests and certifications:
- .1 The manufacturer shall perform the efficiency test and indicate the maximum numbers for the no load loss, and losses at different loads.
- 3.1.3 Energize transformers and apply incremental loads:
- .1 0% for 4 hours.
  - .2 10% for next 1 hour.
  - .3 25% for next 2 hours.
  - .4 50% for next 3 hours.
  - .5 Full load.
  - .6 At each load change, check temperatures ambient, enclosure, ventilating air, winding.
  - .7 Adjust cooling fan controls if required.
- 3.1.4 A certified rest report shall be provided to the consultant.

### **3.2 INSTALLATION / QUALITY CONTROL**

- 3.2.1 The manufacturer shall include in their bid provision of the services of a qualified factory-trained manufacturer's representative to assist the contractor in installation and start-up of the equipment specified under this section for a period of four (2) non consecutive working days (or 16 hours in seven non consecutive working days). The manufacturer's representative shall provide technical direction and assistance to the contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained herein.

- 3.2.2 Onsite tests shall be carried out by the installation contractor prior to placing the equipment in service. Perform minimum visual and electrical tests based on manufacturer's recommendations.
- 3.2.3 Check transformer for dryness before putting it into service and if it has not been energized for some considerable time.
- 3.2.4 A qualified factory trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with manufacturer's recommendations.
- 3.2.5 The manufacturer shall provide three copies of field startup report to the Engineer.
- 3.2.6 The Owner or designated representative shall coordinate the commissioning of the complete facility.
- 3.2.7 Manufacturer to:
- .1 Provide commissioning services as part of a coordinated effort for the total facility.
  - .2 Certify installation using factory trained service personnel
  - .3 Startup and commission the switchgear with a factory trained technology center engineer or technician.
  - .4 Carry out on-site performance verification tests.
  - .5 Confirm correct connections and interfacing with plant digital control system.
  - .6 Demonstrate operation and maintenance.
  - .7 Provide performance tests.
- 3.2.8 Vendor inspection reports shall be provided to the Owner, after each visit during installation, commissioning, startup and post startup.
- 3.2.9 The manufacturer shall indicate in the tender the amount allocated for start-up and commissioning. Field time allocated for field installation assistance and rates for additional field time. Provide Engineer at least 48 hours notice prior to inspection, tests and demonstrations.
- 3.2.10 Coordinate testing with supplier of 4.16KV switchgear equipment for the proper power connections and assembly coordination.
- 3.2.11 Coordinate with all the equipment suppliers regarding all intricacies of installation, including the design, size and weight of all equipment.
- 3.2.12 Coordinate with all the equipment supplier for the exact dimensions, tolerances and configuration of all work including pads and penetrations.
- 3.3 MANUFACTURER'S CERTIFICATION**
- 3.3.1 A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.
- 3.3.2 The manufacturer shall provide three copies of the certificate.

### **3.4 TRAINING**

- 3.4.1 The contractor shall provide a training session for up to 1/2 workdays with owner's representatives at a jobsite location determined by the owner.
- 3.4.2 The training session shall be conducted by a manufacturer's qualified representative. The training program shall consist of the instruction on the operation of the assembly, circuit breakers and major components within the assembly.

### **3.5 FOLLOW UP SITE INSPECTION VISITS**

- 3.5.1 The manufacturer shall include in his bid two (2) site visits during the first year of the guarantee period and one visit at the end of the second year. These visits during the first year shall be at intervals agreed with the Owner. The manufacturer shall carry out the following procedures at each visit:
- .1 Check and adjust the system and measure performance.
  - .2 Visually inspect the system.
  - .3 Recommend and show how maintenance can be performed and possibly be improved.

**END OF SECTION**