This master should be used by designers working on Port of Portland construction projects and by designers working for PDX tenants (“Tenants”). Usage notes highlight a few specific editing choices, however the entire section should be evaluated and edited to fit specific project needs.

SECTION 261216 - CAST COIL SUBSTATION TRANSFORMERS

1. GENERAL
   * + 1. DESCRIPTION
          1. This section describes cast coil unit substation transformers.
       2. RELATED WORK SPECIFIED ELSEWHERE
          1. Section 261100, Substations
          2. Section 262300, Low-Voltage Draw-Out Metal-Enclosed Switchgear
       3. REFERENCES
          1. The substation transformers and all components shall be designed, manufactured, and tested in accordance with the following standards:

ANSI: American National Standards Institute

ANSI C57.12.00: Liquid-Immersed Distribution Power and Regulating Transformers

IEEE: Institute of Electrical and Electronic Engineers

IEEE 357.124

NEMA: National Electrical Manufacturers Association

NEMA TR 1: Transformers, Regulators, and Reactors

* + - 1. SUBMITTALS
         1. Submit the following no later than 30 days after issuance of Notice to Proceed:

Master drawing index.

Front view elevation and weight.

Floor plan.

Schematic diagrams.

Nameplate diagram.

Component list.

Conduit entry/exit locations.

Ratings including:

kVA.

Primary and secondary voltage.

Taps.

Primary and secondary continuous current.

Basic impulse level.

Impedance.

Insulation class and temperature rise.

Sound level.

Cable terminal sizes.

Busway connection.

Connection details between close-coupled assemblies.

Composite floor plan of close-coupled assemblies.

* + - * 1. Submit the following upon substantial completion of the work:

Final as-built drawings and information.

Wiring diagrams.

Certified production test reports (four copies).

Installation information.

Seismic certification and equipment anchorage details.

Instruction books and/or leaflets.

Recommended renewal parts list.

Manufacturer’s certification (four copies).

* + - 1. QUALITY ASSURANCE
         1. The manufacturer shall have produced similar electrical equipment for a minimum period of ten years. When requested by the Port, provide an acceptable list of installations with similar equipment demonstrating compliance with this requirement.
      2. DELIVERY, STORAGE, AND HANDLING
         1. Handle and store equipment in accordance with the manufacturer’s instructions. Include one copy of the instructions with the equipment at time of shipment.

1. PRODUCTS
   * + 1. ACCEPTABLE TRANSFORMER MANUFACTURERS
          1. General Electric, Square D Company, Siemens, Eaton Cutler-Hammer, or pre-bid approved equal.
       2. RATINGS
          1. The ratings of the unit substations 4D1T-7A/4D1T-7B transformers shall be as follows:

|  |  |  |
| --- | --- | --- |
| kVA Rating | 2000/2660kVA | OA (self cooled)/FA (fan cooled) |
| Impedance | 5.75% |  |
| HV | 12.47kV | kV-Delta |
| HV BIL | 95kV | kV |
| HV Taps | Two 2 1/2% above and below | 2 - 2 1/2% FCAN & FCBN full capacity |
| LV | 277Y/480V | Volts-Wye |
| LV BIL | 30kV | kV |

* + - * 1. The ratings of the unit substation E4D1T-7B transformer shall be as follows:

|  |  |  |
| --- | --- | --- |
| kVA Rating | 750/1000kVA | OA (self cooled)/FA (fan cooled) |
| Impedance | 5.75% |  |
| HV | 4.16kV | kV-Delta |
| HV BIL | 60kV | kV |
| HV Taps | Two 2 1/2% above and below | 2 - 2 1/2% FCAN & FCBN full capacity |
| LV | 277Y/480V | Volts-Wye |
| LV BIL | 30kV | kV |

* + - * 1. Energy consumption is of concern. Provide a transformer with superior operational economic benefits to the Port.

Analysis shall be made assuming operational duration at the following load percentages:

60 percent of time at 50 percent load.

30 percent of time at 75 percent load.

10 percent of time at 100 percent load.

Port energy cost is 3.5 cents per KWH.

* + - 1. CONSTRUCTION
         1. Provide forced air (FA) units and contain all necessary components and wiring, including fans, for automatically increasing the kVA rating by 33 percent. Include an electronic temperature monitor and fan control unit. The temperature monitor and fan control shall include digital readout, GREEN – power on, YELLOW – fan on, RED – high temperature indicating lights; audible high temperature alarm with alarm silence push button; maximum temperature memory with read and reset switch; auto/manual fan control switch, system test switch; temperature sensing in all three low-voltage coils. Provide auxiliary alarm contact and means for remote control and temperature monitoring. Provide control power from a control power transformer in the secondary equipment.
         2. The electrical insulation system shall utilize Class F material in a fully rated 185ºC system. Transformer design temperature rise shall be based on a 30ºC average ambient over a 24-hour period with a maximum of 40ºC. Solid insulation in the transformer shall consist of inorganic materials such as glass fiber, electrical grade epoxy, and Nomex, or equal. All insulating materials shall be rated for continuous 185ºC duty.
         3. For enhanced environmental protection and improved withstandability to thermal shock and short-circuit stresses, the primary and secondary coil assemblies shall be of cast coil design. Each cast coil shall be cast under vacuum to assure complete, void-free epoxy resin impregnation throughout the entire insulation system.
         4. The average temperature rise of the transformer windings shall not exceed 80ºC when the transformer is operated at full nameplate rating. The transformer(s) shall be capable of carrying 100 percent of nameplate kVA rating in a 40ºC maximum, 30ºC average ambient temperature as defined by ANSI C57.12.00.
         5. High- and low-voltage windings may be copper or aluminum.
         6. Supply the transformer in a knockdown case design, for ease in fitting through limited openings, and shall be constructed of heavy-gauge sheet steel, minimum of 12 gauge, equipped with removable panels for access to the core and coils. Front and rear panels shall incorporate ventilating grills.
         7. Design the transformer to meet the sound level standards for dry transformers as defined in NEMA TR1.
      2. FINISH
         1. Each transformer shall be painted utilizing an initial phosphatizing cleaning treatment, followed by manufacturer’s standard paint process baked on to a total of 3 to 5 mils average thickness. Paint in accordance with ANSI 61 for indoor service and shall match the primary and secondary equipment.
      3. ACCESSORIES
         1. Transformer shall include:

Provisions for lifting, jacking, and moving on pipe rollers.

Two ground pads.

* + - 1. TERMINAL COMPARTMENTS
         1. The transformer unit shall include a high-voltage metal-enclosed T-entry terminal compartment and a busway flange. Connections between the primary device and transformer shall be bus, and connections between the transformer and secondary shall be flexible bus braid. Provide space and provisions for indoor-type stress cones and for connecting a No. 4/0 ground conductor.

1. EXECUTION
   * + 1. FACTORY TESTING
          1. Perform the following standard factory tests on all equipment provided under this section. Comply with ANSI and NEMA standards.

Resistance measurements of all windings on the rated voltage connection of each unit and at the tap extremes of one unit only of a given rating.

Ratio tests on the rated voltage connection and on all tap connections.

Polarity and phase-relation tests on the rated voltage connections.

No-load loss at rated voltage on the rated voltage connection.

Exciting current at rated voltage on the rated voltage connection.

Impedance and load loss at rated current on the rated voltage connection of each unit and on the tap extremes.

Applied potential test.

Induced potential tests.

Partial discharge test in accordance with IEEE 357.124.

* + - * 1. Perform temperature test(s) on all units in accordance with ANSI and NEMA standards. Tests will not be required when there is a record of a temperature test available on an essentially duplicate unit. When a transformer is supplied with auxiliary cooling equipment to provide more than one rating, temperature tests as listed above shall be made on the lowest kVA OA or AA rating and the highest kVA FA rating.
      1. INSTALLATION
         1. Install equipment in accordance with the manufacturer’s recommendations and the drawings.
      2. MANUFACTURER’S CERTIFICATION
         1. Ensure that a qualified factory-trained manufacturer’s representative certifies in writing that the equipment has been installed, adjusted, and tested in accordance with the manufacturer’s recommendations.

END OF SECTION 261216