

V. Design, Application, Maintenance & Operation Technical Requirements

V.O Relay and Control Building Requirements

1.0 General Requirements

- 1.1 This document outlines the mechanical and electric requirements for relay and control buildings.
- 1.2 The building shall be suitably designed and constructed to contain all substation control and instrument panels, relay panels, metering panels, AC lighting and power panels, Annunciator, DFR, SCADA equipment, DC station batteries, DC Power Panels, battery chargers, toilet facilities (when required), office furniture, HVAC equipment, and local required telecommunications. 3rd-party telecommunication equipment is not permitted to be installed in the control building, unless it is permitted by the Transmission Owner (TO). Consideration should be given to either sizing the building to accommodate the needs of the ultimate station development or to allow for the expansion for such accommodation.
- 1.3 Control Building is not to be part of the Substation fence.
- 1.4 All materials and equipment used in the control building shall be noncombustible.
- 1.5 All internal equipment and devices are to be labeled as per the TO requirements.

2.0 Specification

- 2.1 The building is to be designed and constructed in accordance with all applicable codes including but not limited to:
 - 2.1.1 International Building Code (IBC) - Latest Edition.
 - 2.1.2 ASCE 7 - (American Society of Civil Engineers) – Minimum Design Loads for Buildings and Other Structures.
 - 2.1.3 AISC (American Institute of Steel Construction) Manual of Steel Construction - Latest Edition.
 - 2.1.4 NFPA (National Fire Protection Association) Codes - Latest Edition.
 - 2.1.5 NFPA 70 - NEC (National Electric Code) - Latest Edition (Refer to the NEC to determine what areas are applicable to these facilities).
 - 2.1.6 IEEE C2 - NESC (National Electrical Safety Code).
 - 2.1.7 And be in accordance with all applicable local building codes and requirements.
- 2.2 Structural, Architectural, and Mechanical Requirements

2.2.1 The building shall be designed in accordance with (IBC) and as specified below:
Building is to be sized to house all the necessary indoor equipment for the substation.

1. This building is not intended to be used as a shop.
2. Not intended to be used as a storage location for spare parts.
3. Not intended to be used for equipment assembly.

2.2.2 Building design loads shall include live, snow, wind, and dead load. In addition, building must be designed to carry the auxiliary static loading from interior cable tray systems and air handling ductwork, and additional electrical equipment such a battery chargers, power panels etc.

2.2.3 Typically, two exits with panic bar and door holder mechanism will be required. It is recommended that one exit be a double door and the second exit be a 'single personnel door'. The double door needs to be high enough to accept delivery of control and power panels (usually 8'-0" door height). A roll up garage door is acceptable in lieu of double doors.

2.2.4 Building ceiling and walls to be insulated. Vapor barriers are to be provided.

2.2.5 Gutters, downspouts, and splash block diffusers may be required by the TO.

2.2.6 Typically, a minimum of two control cable entrances are recommended. Consideration should be given to designating one as a primary control cable entrance and the other as the secondary (back-up) entrance in order to promote a diverse routing practice for the relay and control cables. In addition, consideration should be given to separate cable entrances for the main and reserve AC station service feeders. Control cable entrances are to be sealed off to prohibit rodents from entering.

2.3 Heating, Cooling, and Ventilation

2.3.1 The building shall be equipped with sufficient heating, cooling (if required by TO), and ventilation equipment to provide acceptable ambient temperatures within the building so as not to impact the operation and life expectancy of the control equipment within. (Automatic temperature control to be provided). Microprocessor relay and control equipment and the control battery manufacturers should be consulted to establish proper ranges of operation.

2.3.2 Adequate ventilation shall be provided to prevent the accumulation of hydrogen gasses resulting from battery operation. Forced ventilation shall be used when required.

2.4 Illumination

2.4.1 See Table 111-1 of the National Electrical Safety Code for minimum illumination levels. Ref. <http://engineerboards.com/index.php?/topic/16992-nesc/>

2.4.2 Interior lighting shall be properly designed for long life and low maintenance.

2.4.3 Emergency lighting shall be provided. Automatic initiation may be required. Illumination levels must meet the minimum requirements specified by the National

Electrical Safety Code for egress, and should be sufficient for the safe and efficient operation of the equipment within.

2.4.4 Exterior lighting at doorways shall be provided to effect safe access to the building.

2.4.5 Exit lights are to be provided in accordance with local codes. These lights may be required to be connected to the emergency lighting circuit.

2.5 Grounding

2.5.1 Structural building steel, raceways, relay and control panels, and AC and DC distribution panels (not the DC control voltage itself) shall be bonded to the station ground grid in accordance with the NEC and NESC.

2.5.2 Each control and relay panel shall be equipped with a ground bus to which instrument transformer secondary circuits or other equipment such as relay case grounds can be grounded.

2.5.3 Cable tray system shall be provided with a continuous run of copper wire for grounding purposes. Cable to be bonded to cable ladder system at a minimum of once per cable ladder section.

3.0 Application and Special Considerations

3.1 Raceways

3.1.1 Control cables are to be installed in overhead cable tray raceway, or under the floor if a raised computer floor is used, or in under floor cable troughs, per the preference of the TO. Raceways are to be suspended from building ceiling. Cable tray shall be aluminum or galvanized steel construction (per the TO preference) and be sized adequately for anticipated cable loads. Mechanical protection may be needed on vertical raceway sections to a height of 7' - 0" in high traffic areas.

3.1.2 Nonmetallic jacketed cables below 7 ft above the floor level not in ladder tray or otherwise suitably protected should be enclosed in conduit.

3.2 Working Space

3.2.1 A minimum of 3 ft working clearance shall be provided in front of all panels/batteries and 3 ft in back of panels where rear connected equipment access is required. See NESC Rule 125 for additional information.

3.2.2 A desk and Filing cabinet should be provided for operational support purposes.

3.3 Safety Equipment

3.3.1 Signage as required by the NESC, OSHA, and other applicable organizations shall be provided. Signage is to be in accordance with ANSI Standards Z535.1, Z535.2, Z535.3, Z535.4, and Z535.5, latest revision.

3.3.2 Fire detection and extinguishing equipment shall be installed in accordance with all applicable national and local codes.

3.3.3 Face shields and eyewash stations shall meet applicable OSHA requirements.

3.3.4 Provisions for containing acid spillage from the control battery should be included in design of the facility. Shielding may be required by TO.

3.4 Security

3.4.1 Security monitoring shall be properly designed and operated per applicable regulatory requirements.

3.5 Plumbing and Toilet Facilities (if required by TO)

3.5.1 Must be in accordance with all applicable local building codes and requirements.

3.6 DC Requirements

3.6.1 Refer to the appropriate section of the PJM TSS Transmission Owner Guidelines on the PJM web site. See section V.J. Substation Batteries and Chargers, and Section V.K. DC Station Service.

3.7 AC Requirements

3.7.1 Refer to the appropriate section of the PJM TSS Transmission Owner Guidelines on the PJM web site. See section V.I. AC Station Service.

3.8 Metering, System Protection, Annunciator, DFR, SCADA, and Telecommunications

3.8.1 For specific information and details pertaining to protection design schemes, relaying requirements, under frequency relaying requirements, SCADA requirements, etc. see the Protective Relaying Philosophy and Design Guidelines, as prepared and posted by the PJM Relay Subcommittee, as well as consulting with the TO.

3.8.2 The local telecommunications provider shall be consulted for their requirements for space, access, conduit size and routing, working clearances, auxiliary power, grounding, and other aspects of the installation. Isolation equipment may be required to protect telephone equipment from voltage rises. A telephone is required.

3.8.3 Free standing or rack mounted panels are acceptable.

3.8.4 Controls panels and equipment must be arranged in such a manner to allow for safe and reliable operation and maintenance activities of the substation.