

## Designated Entity Design Standards Task Force (DEDSTF)

### Minimum Design Requirements for FERC Order 1000 Projects

#### System Protection Subgroup

For any substation facility included in the scope of a transmission project subject to a Designated Entity Agreement (DEA), the following minimum system protection, metering, and control requirements apply.

#### 1. System Protection Engineering and Design Requirements for Facilities that Interconnect to Existing Incumbent Transmission Owners (All Voltage Levels)

For transmission circuits and other facilities with protective zones that are shared with existing incumbent Transmission Owners (i.e., facilities that represent ties between existing substations owned by incumbent Transmission Owners and Designated Entity substation facilities, etc.), the parties must coordinate to develop a protection system design that does not degrade the performance of the system, following the applicable technical requirements and standards of the Transmission Owner that are posted on PJM's website per Manual 14C Section 6.1.3.2., or other mutually agreed to solution including but not limited to the items listed below. When interconnecting to multiple Transmission Owners systems, all parties must coordinate to achieve a mutually agreed upon solution.

- Line relay scheme (DCB, POTT, current diff, etc.)
- Line relay types/models
- Line protection communication media (Fiber, Power Line Carrier, etc.)
- Line protection communication scheme requirements – number of channels, channel types (POTT, DCB, DTT, etc.), and channel performance requirements
- Line Relay Settings and Trip Logic design practices and philosophies.
- Design must include sufficient test switches to allow isolation of failed protection system components and to provide adequate isolation to maintain protection system components and minimize trips caused by testing maintenance to be performed without taking any primary element out of service (e.g., line, transformer, bus)
- Reclosing method (HBDL, sync check, etc.) and associated timing must be coordinated with the local TO

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**Comment [MWJ1]:** Whether or not a primary element should come out of service isn't necessarily totally dependent on whether there are sufficient test switches. IPPs don't necessarily have enough test switches to allow transfer trip receivers to be pulled or current diffs to be isolated and this has led to a number of false trips. BGE has had the same issues and I'd imagine a number of others have as well.

#### 2. System Protection Requirements for Facilities That Do Not Directly Interconnect with Existing Substations Owned by Incumbent Transmission Owners (Greater than 200kV)

Facilities with protective zones that are not shared with incumbent Transmission Owners or Generation Owners are not subject to DEA section 4.2 (i.e., facilities entirely within a Designated Entity substation or a facility that interconnects two Designated Entity substation

facilities, etc. PJM Manual 07 will apply to the following Designated Entity equipment as minimum design standards for system protection, metering, and control:

- Substation Buses (Manual 07, Section 9)
- Breaker Failure Protection (Manual 07, Section 12)
- Transmission Substation Transformers (Manual 07, Section 8)
- Shunt Reactors and Capacitors (Manual 07, Section 10 and 11)
- Phase Angle Regulating and Voltage Regulating Transformers (Manual 07, Section 13)
- HVDC Transmission Circuits and Converters (No Coverage in Manual 07)

Note 1: Minimum system protection requirements for HVDC Transmission Circuits and associated converter equipment shall be determined on a case-by-case basis and included in the applicable PJM Problem Statement & Requirements Document. At a minimum, completely redundant protection systems will be required for these elements.

Note 2: For phase angle regulators (PAR) at a Designated Entity station that are electrically located at the terminal of a transmission line with a shared protection zone, design and relay setting coordination between the Designated Entity facility and the incumbent Transmission Owner facility is required. The required protection schemes on a PAR are inherently complex, and can adversely affect reliability of the incumbent Transmission Owner system. In these cases, agreement on scope of design and protection philosophy, relay settings and test methods may be required by the incumbent Transmission Owner.

Note 3: Breaker failure design, timing requirements and relay types must be coordinated between the Designated Entity and the Incumbent Transmission Owner prior to the design of the protection system for all breakers in the Designated Entity station. Where generator stability is a concern, the protection requirements must be fully understood by the Designated Entity prior to the selection of relay types and overall design of the breaker failure scheme.

### **3. System Protection Requirements for Facilities less than 200kV**

**Comment [MWJ2]:** I'd bring up to the group to consider that this section isn't necessary as it will be covered in section 1. Use your judgment.

For protection systems in the substation subject to a Designated Entity Agreement that do not meet the applicability of PJM Manual 07 because they are less than 200kV, Appendix A lists the minimum requirements for those protection systems.

## **Appendix A**

This appendix outlines the protection requirements for the protection of greenfield project facilities at system voltages below 200kV but limited to 46kV.

### **Generator Protection**

For generating units less than 100 MVA and connected below 200 kV, see PJM M07 Appendix D

### **Unit Power Transformer and Lead Protection**

PJM Manual 07 Section 4 applies for unit power transformers and associated high-side leads where the transformers are (1) rated less than 100 MVA, or (2) are connected to utility systems at transmission system voltages below 200kV.

### **Unit Auxiliary Transformer and Lead Protection**

PJM Manual 07 Section 5 applies for unit-connected auxiliary transformers and associated high-side leads where the transformers are (1) rated less than 100 MVA, or (2) are connected to utility systems at transmission system voltages below 200kV.

### **Start-up Station Service Transformer and Lead Protection**

PJM Manual 07 Section 6 applies for start-up station service transformers and associated high and low-side leads connected to transmission systems at system voltages below 200kV.

### **Line Protection**

PJM Manual 07 Section 7 applies for the protection of lines at system voltages below 200kV except for following requirements:

#### **Primary Protection**

- For transmission lines below 200kV, pilot protection may be required to meet coordination requirements of the interconnected Transmission Owner.

#### **Restricted Ground Fault Protection**

- Not required for transmission lines below 200kV

#### **Close-in Multi-Phase Fault Protection (Switch-Onto-Fault Protection)**

- Not required for transmission lines below **100kV**

### **Substation Transformer Protection**

PJM Manual 07 Section 8 applies for the protection of substation transformers with high-side voltages of below 200kV except for following requirements:

#### **Current Differential Zone Considerations**

- Not required for substation transformers with high-side voltages below 200kV

### **Isolation of a Faulted Transformer Tapped to a Line**

- PJM Manual 07 Section 8.2 applies since bulk power lines operated below 300 kV may be tapped with the concurrence of the transmission line owner(s).

#### **Protection Scheme Requirements**

- A device failure scheme for the fault interrupting device is not required for substation transformers with high-side voltages below 200kV.

### **Transformer Leads Protection**

- High and low side leads of transformers with high-side voltages below **100kV** must be protected by two independent schemes, only one of which must be high-speed. If the leads are included in a line protection zone, transformer lead protection is not required.

### **Bus Protection**

- For the protection of substation buses at system voltages below **100kV**, one high speed protection scheme is required for protecting the bus. Remote or local protection is required as a backup. The schemes must utilize independent current and/or voltage sources and independently protected DC control circuits.

### **Shunt Reactor Protection**

PJM Manual 07 Section 10 applies for the protection of shunt reactors at system voltages below 200kV.

### **Shunt Capacitor Protection**

PJM Manual 07 Section 11 applies for the protection of shunt capacitors at system voltages below 200kV with the following exception:

#### **Unbalance Detection Scheme**

- For facilities below 200kV, one capacitor bank unbalance detection scheme must be installed.

### **Breaker Failure Protection**

PJM Manual 07 Section 12 applies for breaker failure protection at system voltages below 200kV with the following exception:

#### **Local breaker failure protection requirements**

- For facilities below 100kV, a dedicated breaker failure scheme shall be used for each fault-interrupting device and shall initiate tripping of all local sources of fault current only if the remote backup protection is inadequate.

### **Phase Angle Regulator Protection**

PJM Manual 07 Section 13 applies for the protection of phase angle regulating transformers connected at system voltages below 200kV.

**Transmission Line Reclosing**

PJM Manual 07 Section 14 applies for automatic reclosing schemes for fault interrupting devices at system voltages below 200kV.

**Supervision and Alarming of Relaying and Control Circuits**

PJM Manual 07 Section 15 applies for supervision and alarming of relaying and control circuits applied to protect equipment at system voltages below 200kV.

**Underfrequency Load Shedding**

PJM Manual 07 Section 16 applies for underfrequency load shedding schemes at system voltages below 200kV.

**Special Protection Schemes**

PJM Manual 07 Section 17 applies for Special Protection Schemes (SPSs) at system voltages below 200kV.

**Use of Dual Trip Coils**

The use of dual trip coils in circuit breakers are not required at system voltages below 100kV

**Direct Transfer Trip Requirements**

PJM Manual 07 Appendix B applies for facilities below 200kV.

**Dual Pilot Channels for Protective Relaying**

PJM Manual 07 Appendix C applies for facilities below 200kV.

**Small Generator Protection Requirements**

PJM Appendix D applies for generating units less than 100 MVA and connected below 200kV.

**Acceptable Three Terminal Line Applications**

PJM Manual 07 Appendix E applies for facilities below 200kV with the following exception:

**Protection Requirements**

- For facilities below 200kV, directional comparison blocking (DCB) or unblocking scheme (DCUB) operating over power line carrier to a third terminal is acceptable for primary or backup line protection.