

Designated Entity Design Standards Task Force (DEDSTF)

Minimum Design Requirements for FERC Order 1000 Projects

System Protection Subgroup

For any ~~Competitive S~~ubstation ~~F~~acility included in the scope of a ~~Competitive~~ ~~T~~ransmission ~~P~~roject subject to a Designated Entity Agreement, 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

For ~~T~~ransmission ~~C~~ircuits 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 Competitive S~~ubstation ~~F~~acilities, 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 for the items listed below. When interconnecting to multiple ~~T~~ransmission ~~O~~wners 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
- Design must allow protection system 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
- ~~Breaker failure timing must be coordinated per NERC Standard PRC-001.~~

Protection System Design Reliability [not for inclusion in the minimum design standard but for recommendation for discussion by the Relay Subcommittee]

The PJM RS is going to discuss if a “Protection System Reliability” section should be added to PJM M07. This section should address minimum Rack separation requirements and, possibly maintenance requirements (design with test switches to ensure that relays can be removed from service for testing without removing a BES element from service).

2. System Protection Requirements for Facilities That Do Not Directly Interconnect with Existing Substations Owned by Incumbent Transmission Owners

For facilities with protective zones that are not shared with incumbent Transmission Owners or Generation Owners (i.e., facilities entirely within a Designated Entity Competitive s Substation f Facility or facility ies that interconnects two Designated Entity Competitive s Substation f Facilities, etc.), PJM Manual 07 will apply to the following 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 Request for Proposal PJM Problem Statement & Requirements Document. At a minimum, completely redundant protection systems will be required for these elements.

Note 2: For p Phase a Angle r Regulators (PAR) at a Designated Entity Developer 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 Developer and the incumbent Transmission Owner facility Local T.O. is required. The required p Protection schemes on a PAR are inherently complex, and can adversely affect reliability of the incumbent Transmission Owner Local T.O. 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 Local T.O.

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

3. Facilities not covered under DEA Section 4.2

Relay schemes that are not applicable to DEA 4.2

Relay schemes that are not applicable to DEA 4.2 are those not related to the line protection schemes/systems (or schemes that are shared by the local T.O. Incumbent Transmission Owner)

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and the Developer Designated Entity) as outlined above. For these schemes, the Developer Designated Entity must follow the requirements of PJM Manual 07.

Relay protection review

The overall review of the Developer design is an issue that will be brought to the PJM Planning Committee to determine how best to address.

Protection System Design Reliability

The PJM RS is going to discuss if a "Protection System Reliability" section should be added to PJM M7. This section should address minimum Rack separation requirements, possibly maintenance requirements (design with test switches to ensure that relays can be removed from service for testing without removing a BES element from service)

Additional requirements

All protection schemes in the PJM footprint are required to follow the PJM Manual 07, "PJM Protection Standards". Additionally, all Developers must follow all applicable NERC reliability standards. For protection systems in the Developer substation subject to a Designated Entity Agreement and that do not meet the applicability of PJM Manual 07 because they are less than 200kV, (for example, protection systems protecting only equipment < 200kV), Appendix A lists the minimum requirements for those protection systems. the PJM Relay Subcommittee has developed a PJM M7 exceptions document.

Individual Interconnection Requirements Document

PJM is currently reviewing the feasibility of using the Interconnections Requirements Document to indicate any performance related technical requirements specific to that Transmission Owner that a potential Developer would need to know. Compliance with NERC FAC 001 requires all Transmission Owners to have an Interconnection Requirements Document. These documents are all currently posted on the PJM website. Developers must follow the requirements in this document when interconnecting with a specific Transmission Owner.

Specific protection requirements (that do not conflict with PJM M7 or DEDSTF final documents) for individual Transmission Owners, as it relates to the design and engineering of a proposed new interconnected facility, can be added to this document to address specific performance related requirements. This will ensure the potential Developer is aware of any additional requirements not addressed in PJM M7 or DEDSTF documents. (ie breaker failure timing requirements near a large generating facility).

If the use of this document for that purpose is not feasible, then the DEDSTF would either add an appendix with each PJM Member relay requirements, or create a new document.

Comment [SEG1]: This is already required by DEA paragraph 4.0.

4.0 Construction of Project by Designated Entity.

Designated Entity shall design, engineer, procure, install and construct the Project, including any modifications thereto, in accordance with: (i) the terms of this Agreement, including but not limited to the Scope of Work in Schedule B and the Development Schedule in Schedule C; (ii) applicable reliability principles, guidelines, and standards of the Applicable Regional Reliability Council and NERC; (iii) the Operating Agreement; (iv) the PJM Manuals; and (v) Good Utility Practice.

Appendix A

This appendix outlines the protection requirements for the protection of gGreenfield project facilities at system voltages below 200kV but limited to 46kV. This appendix is applicable to new gGreenfield projects approved after April 1, 2017.

Section 1: Generator Protection

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

Section 2: 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.

Section 3: 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.

Section 4: 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.

Section 5: 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

Section 6: Substation Transformer Protection

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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.

Section 7: 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.

Section 8: Shunt Reactor Protection

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

Section 9: 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.

Section 10: 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.

Section 11: Phase Angle Regulator Protection

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

Section 12: Transmission Line Reclosing

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

Section 13: 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.

Section 14: Underfrequency Load Shedding

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

Section 15: Special Protection Schemes

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

Section 16: Use of Dual Trip Coils

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

Section 17: Direct Transfer Trip Requirements

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

Section 18: Dual Pilot Channels for Protective Relaying

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

Section 19: Small Generator Protection Requirements

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

Section 20: 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.