

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.

Comment [JL1]: This document, including M7 does not address requirements for metering as well as DME.

1. System Protection Engineering and Design Requirements for Facilities that Interconnect to Existing Incumbent Transmission Owners

Comment [JL2]: Does section 1 apply only to facilities that are applicable to M7?

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 for 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
- 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

Comment [JL3]: Add statement to introduce this bullet list. Something like "The following are examples of design requirements that must be coordinated between parties".

Comment [NS4]: Should the line relay distance zone 2/time delayed OC settings be also coordinated as mutual agreement?

Comment [JL5]: Add routing requirements?

Comment [NS6]: Does it mean channel time delay coordination for POTT & DCB?

Comment [NS7]: Should breaker failure trip clearing time be also coordinated as mutual agreement?

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 are not subject to DEA section 4.2 (i.e., facilities entirely within a Designated Entity substation facility 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:

Comment [NS8]: I may not have understood this completely. Does this mean that incumbent ties into non-PJM entity but physically in PJM territory?

Comment [NS9]: How is this different than "Facilities that Interconnect to Existing Incumbent Transmission Owners"?

- 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.

Comment [APJ10]: must be approved?

Comment [JL11]: Relay types from a general sense, or is it referring to breaker failure relay types? Does breaker failure relay type need to be coordinated?

3. System Protection Requirements for Facilities less than 200kV not covered under DEA Section 4.2

Comment [NS12]: "below"

Comment [JL13]: If building a 115 kV tie line between a TO and a DE, would section 1 or section 3 apply? See related comment SJ2. Section 1 enforces the TO's standards, while section 3 enforces M7 with a few exceptions.

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

Additional requirements

For protection systems in the substation subject to a Designated Entity Agreement and 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.

Comment [JL14]: M7 applicability also includes facilities 100 kV to 200 kV critical to reliability of BES

Comment [NS15]: "below"

Appendix A

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

Comment [BSA16]: Odd way to say this. Perhaps simply "facilities above 46 kV and below 200 kV"

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.

Comment [BSA17]: Are you trying to say that high speed simultaneous clearing of all line terminals is not required, unless it is needed to meet coordination requirements?

Restricted Ground Fault Protection

- Not required for transmission lines below 200kV

Comment [JL18]: Would prefer a stronger statement that requires pilot as-needed for high speed simultaneous clearing of all terminals and possibly redundant pilot if miscoordination can result from a fault during a communication failure.

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

- Not required for transmission lines below 100kV

Comment [BSA19]: At lower voltages you are much more likely to have a restricted ground fault...

Comment [BSA20]: If you are only applying impedance based protection it is defeated by SOTF conditions and you would have a full loss of protection. How is that acceptable?

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

Comment [JL21]: Is there any appetite for reducing this to 100 kV effectively requiring at least one differential scheme above 100 kv?

Comment [JL22]: I think this means to say that section 8.1 applies but that current –based schemes need not be differential below xxxkV. If so I think I think that's a clearer statement and less subject to misinterpretation.

Comment [BSA23]: Then this isn't an exception... Unless this is a lead in to the Protection System Requirements exception. If that is the case the two should be linked with "however, in the Protection System Requirements subsection...."

But I don't understand that exception either....

Comment [BSA24]: A transformer tapped to a networked transmission line that has a required fault interrupting device will be left to cook if the device fails to operate?

The common application would be to operate a circuit switcher bottle and blade independently so that if the bottle fails to open the switch blade opens, creating a fault that can be cleared by the source relays.

Comment [NS25]: time delayed protection

Comment [NS26]: fused

- 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.

Comment [JL27]: The wording is odd and seems to prohibit local breaker failure protection if remote backup protection is sufficiently sensitive to clear the fault. I suspect it means there is requirement for local breaker failure protection in cases where remote backup is not sensitive to the fault. "Remote backup protection is acceptable for facilities below 100 kV. If this cannot be achieved, a dedicated breaker failure scheme....".

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.

Comment [JL28]: Looking at Manual 7 Section 15, its clear enough, despite the terse title, that protection communication circuits are also included. Because this is a separate document it would help the reader to provide a more explicit statement here.

Underfrequency Load Shedding

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

Comment [NS29]: Would there be load shedding applied for 46kV to 200kV?

Special Protection Schemes

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

Comment [JL30]: PJM accepted RAS term, please use RAS or both.

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.

Comment [NS31]: Does it mean three terminal line?