



NERC TPL-001-5.1

Transmission System Planning Performance Requirements

Stan Sliwa
Lead Engineer, Transmission Planning
Planning Committee
December 6, 2022

- **TPL-001-5**
 - FERC Order issued approving TPL-001-5
 - Docket No. RM19-10-000
 - January 23, 2020
- **TPL-001-5.1**
 - FERC Order issued approving TPL-001-5.1
 - Docket No. RD20-8-000
 - June 10, 2020
 - Errata: Updates incorrect references made in Requirement R2 Part 2.7.
- **Effective Date of Standard: 7/1/2023⁽¹⁾**
 - ⁽¹⁾Requirement R2 Part 2.7: 7/1/2025 – See Implementation Plan

- **Revisions**

- Known outage(s) shall be selected for assessment consistent with a documented outage coordination procedure or technical rationale by the Planning Coordinator or Transmission Planner
- Six month outage duration removed
 - Known outage(s) shall not be excluded solely based upon outage duration.
- Stability analysis now required in Requirement R2 Part 2.4.4.

- **Revisions**

- Minor language updates to Requirement R2 Part 2.1.5

2.1.5. When an entity's spare equipment strategy could result in the unavailability of major Transmission equipment that has a lead time of one year or more (such as a transformer), the impact of this possible unavailability on System performance shall be ~~studied~~assessed. Based upon this assessment, an~~The studies analysis~~ shall be performed for the P0, P1, and P2 categories identified in Table 1 with the conditions that the System is expected to experience during the possible unavailability of the long lead time equipment.

- Stability analysis now required in Requirement R2 Part 2.4.5.

- *“An analysis shall be performed for the selected P1 and P2 category events identified in Table 1 for which the unavailability is expected to produce more severe System impacts on its portion of the BES.”*

Single Points of Failure(SPF) – Table 1

Category	Initial Condition	Event ¹	Fault Type ²	BES Level ³	Interruption of Firm Transmission Service Allowed ⁴	Non-Consequential Load Loss Allowed
P5 Multiple Contingency (Fault plus <u>relay non-redundant component of a Protection System failure to operate</u>)	Normal System	Delayed Fault Clearing due to the failure of a non-redundant <u>relay¹³ component of a Protection System¹³</u> protecting the Faulted element to operate as designed, for one of the following: 1. Generator 2. Transmission Circuit 3. Transformer ⁵ 4. Shunt Device ⁶ 5. Bus Section	SLG	EHV	No ⁹	No
				HV	Yes	Yes

13. Applies For purposes of this standard, non-redundant components of a Protection System to the following consider are as follows:

- a. A single protective relay which responds to electrical quantities, without an alternative (which may or may not respond to electrical quantities) that provides comparable Normal Clearing times;
- b. A single communications system associated with protective functions or types: pilot (#85), distance (#21), differential (#87), current (#50, 51, necessary for correct operation of a communication-aided protection scheme required for Normal Clearing (an exception is a single communications system that is both monitored and reported at a Control Center);
- c. A single station dc supply associated with protective functions required for Normal Clearing (an exception is a single station dc supply that is both monitored and reported at a Control Center for both low voltage (#27 & 59), directional (#32, & 67), and tripping (#86, & 94) and open circuit);
- d. A single control circuitry (including auxiliary relays and lockout relays) associated with protective functions, from the dc supply through and including the trip coil(s) of the circuit breakers or other interrupting devices, required for Normal Clearing (the trip coil may be excluded if it is both monitored and reported at a Control Center).

Table 1 – Steady State & Stability Performance Extreme Events	
<p>Steady State & Stability</p> <p>For all extreme events evaluated:</p> <ol style="list-style-type: none"> a. Simulate the removal of all elements that Protection Systems and automatic controls are expected to disconnect for each Contingency. b. Simulate Normal Clearing unless otherwise specified. 	
<p>Stability</p> <ol style="list-style-type: none"> 1. With an initial condition of a single generator, Transmission circuit, single pole of a DC line, shunt device, or transformer forced out of service, apply a 3Ø fault on another single generator, Transmission circuit, single pole of a different DC line, shunt device, or transformer prior to System adjustments. 2. Local or wide area events affecting the Transmission System such as: <ol style="list-style-type: none"> a. 3Ø fault on generator with stuck breaker¹⁰ or a relay failure¹²-resulting in Delayed Fault Clearing. b. 3Ø fault on Transmission circuit with stuck breaker¹⁰ or a relay failure¹²-resulting in Delayed Fault Clearing. c. 3Ø fault on transformer with stuck breaker¹⁰ or a relay failure¹²-resulting in Delayed Fault Clearing. d. 3Ø fault on bus section with stuck breaker¹⁰ or a relay failure¹²-resulting in Delayed Fault Clearing. <u>e. 3Ø fault on generator with failure of a non-redundant component of a Protection System¹³ resulting in Delayed Fault Clearing.</u> <u>f. 3Ø fault on Transmission circuit with failure of a non-redundant component of a Protection System¹³ resulting in Delayed Fault Clearing.</u> 	<ol style="list-style-type: none"> <u>g. 3Ø fault on transformer with failure of a non-redundant component of a Protection System¹³ resulting in Delayed Fault Clearing.</u> <u>h. 3Ø fault on bus section with failure of a non-redundant component of a Protection System¹³ resulting in Delayed Fault Clearing.</u> <u>e.i.</u> 3Ø internal breaker fault. <u>f.i.</u> Other events based upon operating experience, such as consideration of initiating events that experience suggests may result in wide area disturbances

- TOs to identify protection system SPF in order for PJM to evaluate steady state system performance
 - Scope of P5 events will now include non-redundant components of a Protection System not just relays (Footnote 13)
 - New P5 contingencies that capture the non-redundant components need to be developed
- PJM will study system performance with new P5 contingencies under steady state conditions

- PJM will conduct stability simulations for non-redundant components of a Protection System
 - Planning Event (Category P5) – Single Line to Ground (SLG) faults
 - Extreme Events (Stability 2.e-h) – Three Phase faults
- PJM will require clearing times for SPF to assess system performance

- PJM has been working with the TOs through the PJM Modeling Working Group (MWG) and the PJM Relay Subcommittee (RS) to collect the required information
- PJM is requesting that those TOs that have not provided P5 contingencies and/or clearing time information to please do so as soon as possible.
 - Remaining analysis needs to be completed to meet the July 1, 2023 enforcement date.
- Information can be submitted to:
NERC.Transmission.Planner@pjm.com

Governmental Authorities approve TPL-001-5 & Implementation Plan.

TPL-001-5 becomes effective.

- Changes to R1, R2, R4, and Table 1 enforceable.
- Requirement R2, Part 2.7 not enforceable for non-redundant components of a Protection System identified in Table 1 Category P5, footnote 13, items b, c, and d.
- R3, R5, R6, R7, R8 unchanged.
- *The first annual Planning Assessment shall be completed in accordance with TPL-001-5, but without CAPs for revised P5, by this date.*



CAPs required for all failures to meet Table 1 performance requirements, but the planned System is not required to meet the performance requirements in Table 1 for category P5 events only.

- *All Planning Assessment(s) completed after this date shall include CAPs for failures to meet Table 1 performance requirements for the revised P5, when identified.*

TPL-001-5 fully enforceable.

- PJM will use the 2022 Series RTEP for compliance with TPL-001-4 and TPL-001-5.1
 - TPL-001-4 Planning Assessment to be completed by year's end as done in previous years
 - TPL-001-5.1 Planning Assessment to be completed by July 1, 2023.
- All future year RTEPs will need to be compliant with TPL-001-5.1

SME/Presenter:

Stanley Sliwa,
Stanley.Sliwa@pjm.com

NERC TPL-001-5.1
Transmission System Planning
Performance Requirements



Member Hotline

(610) 666 – 8980

(866) 400 – 8980

custsvc@pjm.com

**PROTECT THE
POWER GRID**
**THINK BEFORE
YOU CLICK!**



Be alert to
malicious
phishing emails.

Report suspicious email activity to PJM.
(610) 666-2244 / it_ops_ctr_shift@pjm.com

