NERC TPL-001-4 – Transmission System Planning Performance Requirements

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FERC Final Rule & Enforcement

- FERC final rule on October 17, 2013 approved NERC's TPL-001-4

- Enforcement dates:
  - Requirements R1 and R7 – January 1, 2015
  - Requirements R2 through R6 and R8 – January 1, 2016

TPL-001-4 Requirements

Requirement	Abbreviated Description
R1	Maintain System models
R2	Prepare an annual assessment (see Table 1)
R3	Study the near-term and longer-term
R4	Perform the stability criteria in Table 1
R5	Criteria - Voltage, including transient voltage response
R6	Criteria - cascading, voltage instability, uncontrolled islanding
R7	The TPs and PCs shall determine study responsibility for the assessment
R8	Distribute results of annual assessment

TPL-001-4 Implementation Work

- June 2012
  - TPL-001-4 discussed at the PJM PC as a future issue that will impact PJM Planning
- July 2012 – January 2013
  - PJM PC began work to draft PJM Manual 14B – PJM Region Transmission Planning to comply with TPL-001-4
  - PJM PC forms a "M14B/TPL" group to develop PJM implementation of specific areas of the new TPL standard related to system stability
- February 2013
  - PJM PC endorses Manual 14B changes required to implement TPL-001-4
- October 17, 2013
  - FERC final rule approves TPL-001-4
- November 4, 2014 PC
  - Review M14B changes to support TPL-001-4 R1 and R7 in advance of enforcement date: 1/1/2015
- November 20, 2014 MRC
  - MRC Endorsed M14B changes to support TPL-001-4 R1 and R7 in advance of enforcement date: 1/1/2015
- Today (August 13, 2015) PC
  - Review previously endorsed M14B language in preparation for MRC first read
- September 10, 2015 PC
  - PC review of M14B language in advance of MRC first read
- October 8, 2015 PC
  - Final PC review of M14B language ahead of MRC first read
  - Endorsement of Administrative updates
- October 22, 2015 MRC
  - First read of M14B changes to support TPL-001-4
- November 19, 2015 MRC (Today)
  - Request MRC approval of M14B

Endorsement

- Administrative changes
  - Blue text changes in Redline Draft
  - Endorsed unanimously by the Planning Committee: October 2015
- Technical Updates
  - Red text changes in Redline Draft
  - Manual language developed and endorsed by the Planning Committee: throughout 2013 and 2014, in anticipation of implementation

Timeline

- Planning Committee
  - Review/First Read – 9/10/2015
  - Final Review/Endorsement – 10/8/2015

- Markets and Reliability Committee
  - First Read – 10/22/2015
  - Request Endorsement – 11/19/2015 (Today)

Version History

- V1: Posted to MRC page of PJM.com – 11/12/2015

Appendix

M14B Administrative Updates for TPL-001-4

- Added TPL-001-4 Table 1 as “Appendix I” to M14B

- Updated References to outgoing TPL standards
  - Category A, B, C and D
  - TPL-001, TPL-002-, TPL-003 and TPL-004

Examples of Administrative Updates

- For Full text updates, see accompanying Redline M14B

2.3.6 Baseline Thermal Analysis

Baseline thermal analysis is a thorough analysis of the reference power flow to ensure thermal adequacy based on normal (applicable to system normal conditions prior to contingencies) and emergency (applicable after the occurrence of a contingency) thermal ratings specific to the Transmission Owner facilities being examined. It is based on a 50/50 load forecast from the latest available PJM Load Forecast Report (50% probability that the actual load is higher or lower than the projected load.) It encompasses an exhaustive analysis of all NERC P0-P7~~category A, B and C~~ events and the most critical common mode outages. Final results are supported with AC power flow solutions. The PJM Load Forecast uses a 50/50 distribution minus Energy Efficiency. Demand Response is not considered in the Load Forecast.

PJM Planning SOL Methodology

Consistent with the requirements of NERC Standard TPL-001-4 P0, in the pre-contingency state and with all facilities in service, all facilities shall be within their facility ratings and within voltage and stability limits. In the determination of SOLs, the BES condition used shall reflect expected system conditions and shall reflect changes to system topology such as facility outages.

Following single contingencies as defined in NERC Standard TPL-001-4~~2~~ P1 all facilities should be within their applicable facility ratings and the system shall be transient, dynamic and voltage stable. Cascading outages or uncontrolled separation shall not occur.

Starting with all Facilities in service, the response to a single contingency as defined in NERC Reliability Standard TPL-001-4 P1~~-002~~, may include any of the following:

TPL-001-4 Table 1

Attachment I: Steady State & Stability Performance Planning Events

I.1 NERC TPL-001-4 Table 1

Manual or automatic load shed is not permitted for any P0 - P7 condition.

NERC TPL-001 Events (excludes DC)				PJM		
NERC Category	Initial Condition	Event[1]	Fault Type[2]	Thermal Limits	Low Voltage Limit **	High Voltage Limit **
P0 No Contingency	Normal System	None	N/A	Apply normal limits, the actual % may differ, depending on the TO zone	PJM Planning will use the same voltage limits that are used in PJM Operations for both voltage magnitude and voltage deviation. Emergency limits are used for normal, single contingencies and multiple contingencies.	
P1 Single Contingency	Normal System	Loss of one of the following: 1. Generator 2. Transmission Circuit 3. Transformer[5] 4. Shunt Device[6]	3Ø	Apply emergency limits, the actual % may differ, depending on the TO zone		
P2 Single Contingency	Normal System	1. Opening of a line section w/o a fault [7]	N/A			
		2. Bus Section Fault	SLG			
		3. Internal Breaker Fault [8] (non-Bus-tie Breaker)	SLG			
		4. Internal Breaker Fault (Bus-tie Breaker)[9]	SLG			
P3 Multiple Contingency	Loss of generator unit followed by System adjustments[3]	Loss of one of the following: 1. Generator 2. Transmission Circuit 3. Transformer[5] 4. Shunt Device[6]	3Ø	Normal limits after the 1st contingency, emergency limits after the second contingency.		
P4 Multiple Contingency *(Fault plus stuck breaker[10])*	Normal System	Loss of multiple elements caused by a stuck breaker[10] (non-Bus-tie Breaker) attempting to clear a Fault on one of the following: 1. Generator 2. Transmission Circuit 3. Transformer[5] 4. Shunt Device[6] 5. Bus Section	SLG	Apply emergency limits, the actual % may differ, depending on the TO zone		
P5 Multiple Contingency *(Fault plus relay failure to operate)*	Normal System	Delayed Fault Clearing due to the failure of a non-redundant relay[12] 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			
P6 Multiple Contingency *(Two overlapping singles)*	Loss of one of the following followed by System adjustments.[3] 1. Transmission Circuit 2. Transformer [5] 3. Shunt Device[6] 4. Single pole of a DC line	Loss of one of the following: 1. Transmission Circuit 2. Transformer[5] 3. Shunt Device[6]	3Ø			
P7 Multiple Contingency *(Common Structure)*	Normal System	The loss of any two adjacent (vertically or horizontally) circuits on common structure[11]	SLG			

Overall Technical Requirements

- Event simulation (Table 1)
  - Thermal, voltage limit, voltage stability
- Short Circuit analysis
- Dynamic Simulation
  - Dynamic load modeling
  - Transient voltage recovery

New Processes Required by TPL-001-4

- Interpretation of Footnote 12 regarding non-consequential load loss
- Known outages with duration greater than 6 months
- Transient voltage recovery
- Dynamic Load modeling

New process's required by TPL-001-4

- 75 MW Load Drop
- For P1, P2-1 and P3 (Single and Multiple Contingencies) footnote 12. stating that Non-Consequential load loss should net exceed 75MW applies
- Footnote 12 Stakeholder Process review (Attachment 1)

12. An objective of the planning process is to minimize the likelihood and magnitude of Non-Consequential Load Loss following planning events. In limited circumstances, Non-Consequential Load Loss may be needed throughout the planning horizon to ensure that BES performance requirements are met. However, when Non-Consequential Load Loss is utilized under footnote 12 within the Near-Term Transmission Planning Horizon to address BES performance requirements, such interruption is limited to circumstances where the Non-Consequential Load Loss meets the conditions shown in Attachment 1. In no case can the planned Non-Consequential Load Loss under footnote 12 exceed 75 MW for US registered entities. The amount of planned Non-Consequential Load Loss for a non-US Registered Entity should be implemented in a manner that is consistent with, or under the direction of, the applicable governmental authority or its agency in the non-US jurisdiction.

New process's required by TPL-001-4

- Known Outage(s) of generation of Transmission Facilities with a duration of at least six months (R1.1.2)
- Already applicable, as R1 effective 1/1/2015
- PJM performing analysis in 2015 Calendar year that incudes modeling of these facilities as per eDart outage tickets

New process's required by TPL-001-4

- Transient Voltage Response (R5)
- Criteria for Transient Voltage Response developed by TPL Standards task force in 2013/2014 through a 6+ month stakeholder process
- Manual language included in M14B redline, and already PC endorsed

R5. Each Transmission Planner and Planning Coordinator shall have criteria for acceptable System steady state voltage limits, post-Contingency voltage deviations, and the transient voltage response for its System. For transient voltage response, the criteria shall at a minimum, specify a low voltage level and a maximum length of time that transient voltages may remain below that level. *[Violation Risk Factor: Medium] [Time Horizon: Long-term Planning]*

New process's required by TPL-001-4

- Dynamic Load modeling (R2.4.1 and R2.4.3)
- Recent coordination and progress with the PJM TOs

2.4.1. System peak Load for one of the five years. System peak Load levels shall include a Load model which represents the expected dynamic behavior of Loads that could impact the study area, considering the behavior of induction motor Loads. An aggregate System Load model which represents the overall dynamic behavior of the Load is acceptable.

2.4.3. For each of the studies described in Requirement R2, Parts 2.4.1 and 2.4.2, sensitivity case(s) shall be utilized to demonstrate the impact of changes to the basic assumptions used in the model. To accomplish this, the sensitivity analysis in the Planning Assessment must vary one or more of the following conditions by a sufficient amount to stress the System within a range of credible conditions that demonstrate a measurable change in performance:

- Load level, Load forecast, or dynamic Load model assumptions.
- Expected transfers.
- Expected in service dates of new or modified Transmission Facilities.
- Reactive resource capability.
- Generation additions, retirements, or other dispatch scenarios.

Dynamic Load Modeling Requirement

- TPL-001-4 R2.4.1:

  System peak Load levels shall include a Load model which *represents* the expected dynamic behavior of Loads that could impact the study area, considering the *behavior of induction motor Loads*. An aggregate System Load model which represents the overall dynamic behavior of the Load is acceptable.

- Enforceable – January 1, 2016