

**A. Introduction**

1. **Title:** System Performance Following Extreme Events Resulting in the Loss of Two or More Bulk Electric System Elements (Category D)
2. **Number:** TPL-004-0
3. **Purpose:** System simulations and associated assessments are needed periodically to ensure that reliable systems are developed that meet specified performance requirements, with sufficient lead time and continue to be modified or upgraded as necessary to meet present and future System needs.
4. **Applicability:**
  - 4.1. Planning Authority
  - 4.2. Transmission Planner
5. **Effective Date:** April 1, 2005

**B. Requirements**

- R1. The Planning Authority and Transmission Planner shall each demonstrate through a valid assessment that its portion of the interconnected transmission system is evaluated for the risks and consequences of a number of each of the extreme contingencies that are listed under Category D of Table I. To be valid, the Planning Authority's and Transmission Planner's assessment shall:
  - R1.1. Be made annually.
  - R1.2. Be conducted for near-term (years one through five).
  - R1.3. Be supported by a current or past study and/or system simulation testing that addresses each of the following categories, showing system performance following Category D contingencies of Table I. The specific elements selected (from within each of the following categories) for inclusion in these studies and simulations shall be acceptable to the associated Regional Reliability Organization(s).
    - R1.3.1. Be performed and evaluated only for those Category D contingencies that would produce the more severe system results or impacts. The rationale for the contingencies selected for evaluation shall be available as supporting information. An explanation of why the remaining simulations would produce less severe system results shall be available as supporting information.
    - R1.3.2. Cover critical system conditions and study years as deemed appropriate by the responsible entity.
    - R1.3.3. Be conducted annually unless changes to system conditions do not warrant such analyses.
    - R1.3.4. Have all projected firm transfers modeled.
    - R1.3.5. Include existing and planned facilities.
    - R1.3.6. Include Reactive Power resources to ensure that adequate reactive resources are available to meet system performance.

**R1.3.7.** Include the effects of existing and planned protection systems, including any backup or redundant systems.

**R1.3.8.** Include the effects of existing and planned control devices.

**R1.3.9.** Include the planned (including maintenance) outage of any bulk electric equipment (including protection systems or their components) at those demand levels for which planned (including maintenance) outages are performed.

**R1.4.** Consider all contingencies applicable to Category D.

**R2.** The Planning Authority and Transmission Planner shall each document the results of its reliability assessments and shall annually provide the results to its entities' respective NERC Regional Reliability Organization(s), as required by the Regional Reliability Organization.

#### **C. Measures**

**M1.** The Planning Authority and Transmission Planner shall have a valid assessment for its system responses as specified in Reliability Standard TPL-004-0\_R1.

**M2.** The Planning Authority and Transmission Planner shall provide evidence to its Compliance Monitor that it reported documentation of results of its reliability assessments per Reliability Standard TPL-004-0\_R1.

#### **D. Compliance**

##### **1. Compliance Monitoring Process**

###### **1.1. Compliance Monitoring Responsibility**

Compliance Monitor: Regional Reliability Organization.

Each Compliance Monitor shall report compliance and violations to NERC via the NERC Compliance Reporting Process.

###### **1.2. Compliance Monitoring Period and Reset Timeframe**

Annually.

###### **1.3. Data Retention**

None specified.

###### **1.4. Additional Compliance Information**

None.

##### **2. Levels of Non-Compliance**

**2.1. Level 1:** A valid assessment, as defined above, for the near-term planning horizon is not available.

**2.2. Level 2:** Not applicable.

**2.3. Level 3:** Not applicable.

**2.4. Level 4:** Not applicable.

#### **B. Regional Differences**

**1.** None identified.

## Standard TPL-004-0 — System Performance Following Extreme BES Events

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### Version History

Version	Date	Action	Change Tracking
0	April 1, 2005	Effective Date	New

# Standard TPL-004-0 — System Performance Following Extreme BES Events

**Table I. Transmission System Standards – Normal and Emergency Conditions**

Category	Contingencies	System Limits or Impacts		
	Initiating Event(s) and Contingency Element(s)	System Stable and both Thermal and Voltage Limits within Applicable Rating <sup>a</sup>	Loss of Demand or Curtailed Firm Transfers	Cascading Outages
<b>A</b> No Contingencies	All Facilities in Service	Yes	No	No
<b>B</b> Event resulting in the loss of a single element.	Single Line Ground (SLG) or 3-Phase (3Ø) Fault, with Normal Clearing: 1. Generator 2. Transmission Circuit 3. Transformer Loss of an Element without a Fault.	Yes Yes Yes Yes	No <sup>b</sup> No <sup>b</sup> No <sup>b</sup> No <sup>b</sup>	No No No No
	Single Pole Block, Normal Clearing <sup>c</sup> : 4. Single Pole (dc) Line	Yes	No <sup>b</sup>	No
<b>C</b> Event(s) resulting in the loss of two or more (multiple) elements.	SLG Fault, with Normal Clearing <sup>c</sup> : 1. Bus Section	Yes	Planned/ Controlled <sup>c</sup>	No
	2. Breaker (failure or internal Fault)	Yes	Planned/ Controlled <sup>c</sup>	No
	SLG or 3Ø Fault, with Normal Clearing <sup>c</sup> , Manual System Adjustments, followed by another SLG or 3Ø Fault, with Normal Clearing <sup>c</sup> : 3. Category B (B1, B2, B3, or B4) contingency, manual system adjustments, followed by another Category B (B1, B2, B3, or B4) contingency	Yes	Planned/ Controlled <sup>c</sup>	No
	Bipolar Block, with Normal Clearing <sup>c</sup> : 4. Bipolar (dc) Line Fault (non 3Ø), with Normal Clearing <sup>c</sup> :	Yes	Planned/ Controlled <sup>c</sup>	No
	5. Any two circuits of a multiple circuit towerline <sup>f</sup>	Yes	Planned/ Controlled <sup>c</sup>	No
	SLG Fault, with Delayed Clearing <sup>c</sup> (stuck breaker or protection system failure): 6. Generator	Yes	Planned/ Controlled <sup>c</sup>	No
	7. Transformer	Yes	Planned/ Controlled <sup>c</sup>	No
	8. Transmission Circuit	Yes	Planned/ Controlled <sup>c</sup>	No
	9. Bus Section	Yes	Planned/ Controlled <sup>c</sup>	No

## Standard TPL-004-0 — System Performance Following Extreme BES Events

<p><b>D<sup>d</sup></b></p> <p>Extreme event resulting in two or more (multiple) elements removed or Cascading out of service</p>	<p>3Ø Fault, with Delayed Clearing<sup>e</sup> (stuck breaker or protection system failure):</p> <table><tr><td>1. Generator</td><td>3. Transformer</td></tr><tr><td>2. Transmission Circuit</td><td>4. Bus Section</td></tr></table> <hr/> <p>3Ø Fault, with Normal Clearing<sup>e</sup>:</p> <hr/> <table><tr><td>5. Breaker (failure or internal Fault)</td></tr></table> <hr/> <table><tr><td>6. Loss of towerline with three or more circuits</td></tr><tr><td>7. All transmission lines on a common right-of way</td></tr><tr><td>8. Loss of a substation (one voltage level plus transformers)</td></tr><tr><td>9. Loss of a switching station (one voltage level plus transformers)</td></tr><tr><td>10. Loss of all generating units at a station</td></tr><tr><td>11. Loss of a large Load or major Load center</td></tr><tr><td>12. Failure of a fully redundant Special Protection System (or remedial action scheme) to operate when required</td></tr><tr><td>13. Operation, partial operation, or misoperation of a fully redundant Special Protection System (or Remedial Action Scheme) in response to an event or abnormal system condition for which it was not intended to operate</td></tr><tr><td>14. Impact of severe power swings or oscillations from Disturbances in another Regional Reliability Organization.</td></tr></table>	1. Generator	3. Transformer	2. Transmission Circuit	4. Bus Section	5. Breaker (failure or internal Fault)	6. Loss of towerline with three or more circuits	7. All transmission lines on a common right-of way	8. Loss of a substation (one voltage level plus transformers)	9. Loss of a switching station (one voltage level plus transformers)	10. Loss of all generating units at a station	11. Loss of a large Load or major Load center	12. Failure of a fully redundant Special Protection System (or remedial action scheme) to operate when required	13. Operation, partial operation, or misoperation of a fully redundant Special Protection System (or Remedial Action Scheme) in response to an event or abnormal system condition for which it was not intended to operate	14. Impact of severe power swings or oscillations from Disturbances in another Regional Reliability Organization.	<p>Evaluate for risks and consequences.</p> <ul style="list-style-type: none"><li>▪ May involve substantial loss of customer Demand and generation in a widespread area or areas.</li><li>▪ Portions or all of the interconnected systems may or may not achieve a new, stable operating point.</li><li>▪ Evaluation of these events may require joint studies with neighboring systems.</li></ul>
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2. Transmission Circuit	4. Bus Section															
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14. Impact of severe power swings or oscillations from Disturbances in another Regional Reliability Organization.																

- a) Applicable rating refers to the applicable Normal and Emergency facility thermal Rating or System Voltage Limit as determined and consistently applied by the system or facility owner. Applicable Ratings may include Emergency Ratings applicable for short durations as required to permit operating steps necessary to maintain system control. All Ratings must be established consistent with applicable NERC Reliability Standards addressing Facility Ratings.
- b) Planned or controlled interruption of electric supply to radial customers or some local network customers, connected to or supplied by the Faulted element or by the affected area, may occur in certain areas without impacting the overall reliability of the interconnected transmission systems. To prepare for the next contingency, system adjustments are permitted, including curtailments of contracted Firm (non-recallable reserved) electric power Transfers.
- c) Depending on system design and expected system impacts, the controlled interruption of electric supply to customers (load shedding), the planned removal from service of certain generators, and/or the curtailment of contracted Firm (non-recallable reserved) electric power Transfers may be necessary to maintain the overall reliability of the interconnected transmission systems.
- d) A number of extreme contingencies that are listed under Category D and judged to be critical by the transmission planning entity(ies) will be selected for evaluation. It is not expected that all possible facility outages under each listed contingency of Category D will be evaluated.
- e) Normal clearing is when the protection system operates as designed and the Fault is cleared in the time normally expected with proper functioning of the installed protection systems. Delayed clearing of a Fault is due to failure of any protection system component such as a relay, circuit breaker, or current transformer, and not because of an intentional design delay.
- f) System assessments may exclude these events where multiple circuit towers are used over short distances (e.g., station entrance, river crossings) in accordance with Regional exemption criteria.