

## **Standard TPL-002-0b — System Performance Following Loss of a Single BES Element**

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### **A. Introduction**

- 1. Title:** System Performance Following Loss of a Single Bulk Electric System Element (Category B)
- 2. Number:** TPL-002-0b
- 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:** Immediately after approval of applicable regulatory authorities.

### **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 planned such that the Network can be operated to supply projected customer demands and projected Firm (non-recallable reserved) Transmission Services, at all demand levels over the range of forecast system demands, under the contingency conditions as defined in Category B of Table I. To be valid, the Planning Authority and Transmission Planner assessments shall:
  - R1.1.** Be made annually.
  - R1.2.** Be conducted for near-term (years one through five) and longer-term (years six through ten) planning horizons.
  - 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 B of Table 1 (single contingencies). The specific elements selected (from 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 B 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.

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- R1.3.4.** Be conducted beyond the five-year horizon only as needed to address identified marginal conditions that may have longer lead-time solutions.
- R1.3.5.** Have all projected firm transfers modeled.
- R1.3.6.** Be performed and evaluated for selected demand levels over the range of forecast system Demands.
- R1.3.7.** Demonstrate that system performance meets Category B contingencies.
- R1.3.8.** Include existing and planned facilities.
- R1.3.9.** Include Reactive Power resources to ensure that adequate reactive resources are available to meet system performance.
- R1.3.10.** Include the effects of existing and planned protection systems, including any backup or redundant systems.
- R1.3.11.** Include the effects of existing and planned control devices.
- R1.3.12.** 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.** Address any planned upgrades needed to meet the performance requirements of Category B of Table I.
- R1.5.** Consider all contingencies applicable to Category B.
- R2.** When System simulations indicate an inability of the systems to respond as prescribed in Reliability Standard TPL-002-0\_R1, the Planning Authority and Transmission Planner shall each:
  - R2.1.** Provide a written summary of its plans to achieve the required system performance as described above throughout the planning horizon:
    - R2.1.1.** Including a schedule for implementation.
    - R2.1.2.** Including a discussion of expected required in-service dates of facilities.
    - R2.1.3.** Consider lead times necessary to implement plans.
  - R2.2.** Review, in subsequent annual assessments, (where sufficient lead time exists), the continuing need for identified system facilities. Detailed implementation plans are not needed.
- R3.** The Planning Authority and Transmission Planner shall each document the results of its Reliability Assessments and corrective plans and shall annually provide the results to its respective Regional Reliability Organization(s), as required by the Regional Reliability Organization.

**C. Measures**

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- M1.** The Planning Authority and Transmission Planner shall have a valid assessment and corrective plans as specified in Reliability Standard TPL-002-0\_R1 and TPL-002-0\_R2.
- M2.** The Planning Authority and Transmission Planner shall have evidence it reported documentation of results of its reliability assessments and corrective plans per Reliability Standard TPL-002-0\_R3.

**D. Compliance**

**1. Compliance Monitoring Process**

**1.1. Compliance Monitoring Responsibility**

The British Columbia Utilities Commission

**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:** Not applicable.
- 2.2. Level 2:** A valid assessment and corrective plan for the longer-term planning horizon is not available.
- 2.3. Level 3:** Not applicable.
- 2.4. Level 4:** A valid assessment and corrective plan for the near-term planning horizon is not available.

**E. Regional Differences**

- 1.** None identified.

**Version History**

Version	Date	Action	Change Tracking
0	February 8, 2005	Adopted by NERC Board of Trustees	New
0	April 1, 2005	Effective Date	New
0a	July 30, 2008	Adopted by NERC Board of Trustees	New
0a	October 23, 2008	Added Appendix 1 – Interpretation of TPL-002-0 Requirements R1.3.2 and R1.3.12	Revised

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		and TPL-003-0 Requirements R1.3.2 and R1.3.12 for Ameren and MISO	
0b	November 5, 2009	Added Appendix 2 – Interpretation of R1.3.10 approved by BOT on November 5, 2009	Interpretation
0b	September 15, 2011	FERC Order issued approving the Interpretation of R1.3.10 (FERC Order becomes effective October 24, 2011)	Interpretation

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**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>e</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>e</sup> , Manual System Adjustments, followed by another SLG or 3Ø Fault, with Normal Clearing <sup>e</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>e</sup> : 4. Bipolar (dc) Line Fault (non 3Ø), with Normal Clearing <sup>e</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>e</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

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<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 style="width: 100%; border: none;"> <tr> <td style="width: 50%;">1. Generator</td> <td style="width: 50%;">3. Transformer</td> </tr> <tr> <td>2. Transmission Circuit</td> <td>4. Bus Section</td> </tr> </table> <hr style="border-top: 1px dashed black;"/> <p>3Ø Fault, with Normal Clearing<sup>e</sup>:</p> <hr style="border-top: 1px dashed black;"/> <ol style="list-style-type: none"> <li>5. Breaker (failure or internal Fault)</li> <li>6. Loss of towerline with three or more circuits</li> <li>7. All transmission lines on a common right-of way</li> <li>8. Loss of a substation (one voltage level plus transformers)</li> <li>9. Loss of a switching station (one voltage level plus transformers)</li> <li>10. Loss of all generating units at a station</li> <li>11. Loss of a large Load or major Load center</li> <li>12. Failure of a fully redundant Special Protection System (or remedial action scheme) to operate when required</li> <li>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</li> <li>14. Impact of severe power swings or oscillations from Disturbances in another Regional Reliability Organization.</li> </ol>	1. Generator	3. Transformer	2. Transmission Circuit	4. Bus Section	<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>
1. Generator	3. Transformer					
2. Transmission Circuit	4. Bus Section					

- 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.

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**Appendix 1**

**Interpretation of TPL-002-0 Requirements R1.3.2 and R1.3.12 and  
TPL-003-0 Requirements R1.3.2 and R1.3.12 for Ameren and MISO**

NERC received two requests for interpretation of identical requirements (Requirements R1.3.2 and R1.3.12) in TPL-002-0 and TPL-003-0 from the Midwest ISO and Ameren. These requirements state:

**TPL-002-0:**

[To be valid, the Planning Authority and Transmission Planner assessments shall:]

**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 B of Table 1 (single contingencies). The specific elements selected (from each of the following categories) for inclusion in these studies and simulations shall be acceptable to the associated Regional Reliability Organization(s).

**R1.3.2** Cover critical system conditions and study years as deemed appropriate by the responsible entity.

**R1.3.12** 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.

**TPL-003-0:**

[To be valid, the Planning Authority and Transmission Planner assessments shall:]

**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 C of Table 1 (multiple contingencies). The specific elements selected (from each of the following categories) for inclusion in these studies and simulations shall be acceptable to the associated Regional Reliability Organization(s).

**R1.3.2** Cover critical system conditions and study years as deemed appropriate by the responsible entity.

**R1.3.12** 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.

**Requirement R1.3.2**

**Request for Interpretation of TPL-002-0 and TPL-003-0 Requirement R1.3.2  
Received from Ameren on July 25, 2007:**

*Ameren specifically requests clarification on the phrase, 'critical system conditions' in R1.3.2. Ameren asks if compliance with R1.3.2 requires multiple contingent generating unit Outages as part of possible*

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*generation dispatch scenarios describing critical system conditions for which the system shall be planned and modeled in accordance with the contingency definitions included in Table 1.*

**Request for Interpretation of TPL-002-0 and TPL-003-0 Requirement R1.3.2  
Received from MISO on August 9, 2007:**

*MISO asks if the TPL standards require that any specific dispatch be applied, other than one that is representative of supply of firm demand and transmission service commitments, in the modeling of system contingencies specified in Table 1 in the TPL standards.*

*MISO then asks if a variety of possible dispatch patterns should be included in planning analyses including a probabilistically based dispatch that is representative of generation deficiency scenarios, would it be an appropriate application of the TPL standard to apply the transmission contingency conditions in Category B of Table 1 to these possible dispatch pattern.*

**The following interpretation of TPL-002-0 and TPL-003-0 Requirement R1.3.2 was developed by  
the NERC Planning Committee on March 13, 2008:**

The selection of a credible generation dispatch for the modeling of critical system conditions is within the discretion of the Planning Authority. The Planning Authority was renamed “Planning Coordinator” (PC) in the Functional Model dated February 13, 2007. (TPL -002 and -003 use the former “Planning Authority” name, and the Functional Model terminology was a change in name only and did not affect responsibilities.)

- Under the Functional Model, the Planning Coordinator “Provides and informs Resource Planners, Transmission Planners, and adjacent Planning Coordinators of the methodologies and tools for the simulation of the transmission system” while the Transmission Planner “Receives from the Planning Coordinator methodologies and tools for the analysis and development of transmission expansion plans.” A PC’s selection of “critical system conditions” and its associated generation dispatch falls within the purview of “methodology.”

Furthermore, consistent with this interpretation, a Planning Coordinator would formulate critical system conditions that may involve a range of critical generator unit outages as part of the possible generator dispatch scenarios.

Both TPL-002-0 and TPL-003-0 have a similar measure M1:

- M1.** The Planning Authority and Transmission Planner shall have a valid assessment and corrective plans as specified in Reliability Standard TPL-002-0\_R1 [or TPL-003-0\_R1] and TPL-002-0\_R2 [or TPL-003-0\_R2].”

The Regional Reliability Organization (RRO) is named as the Compliance Monitor in both standards. Pursuant to Federal Energy Regulatory Commission (FERC) Order 693, FERC eliminated the RRO as the appropriate Compliance Monitor for standards and replaced it with the Regional Entity (RE). See paragraph 157 of Order 693. Although the referenced TPL standards still include the reference to the RRO, to be consistent with Order 693, the RRO is replaced by the RE as the Compliance Monitor for this interpretation. As the Compliance Monitor, the RE determines what a “valid assessment” means when

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evaluating studies based upon specific sub-requirements in R1.3 selected by the Planning Coordinator and the Transmission Planner. If a PC has Transmission Planners in more than one region, the REs must coordinate among themselves on compliance matters.

**Requirement R1.3.12**

**Request for Interpretation of TPL-002-0 and TPL-003-0 Requirement R1.3.12  
Received from Ameren on July 25, 2007:**

*Ameren also asks how the inclusion of planned outages should be interpreted with respect to the contingency definitions specified in Table 1 for Categories B and C. Specifically, Ameren asks if R1.3.12 requires that the system be planned to be operated during those conditions associated with planned outages consistent with the performance requirements described in Table 1 plus any unidentified outage.*

**Request for Interpretation of TPL-002-0 and TPL-003-0 Requirement R1.3.12  
Received from MISO on August 9, 2007:**

*MISO asks if the term “planned outages” means only already known/scheduled planned outages that may continue into the planning horizon, or does it include potential planned outages not yet scheduled that may occur at those demand levels for which planned (including maintenance) outages are performed?*

*If the requirement does include not yet scheduled but potential planned outages that could occur in the planning horizon, is the following a proper interpretation of this provision?*

*The system is adequately planned and in accordance with the standard if, in order for a system operator to potentially schedule such a planned outage on the future planned system, planning studies show that a system adjustment (load shed, re-dispatch of generating units in the interconnection, or system reconfiguration) would be required concurrent with taking such a planned outage in order to prepare for a Category B contingency (single element forced out of service)? In other words, should the system in effect be planned to be operated as for a Category C3 n-2 event, even though the first event is a planned base condition?*

*If the requirement is intended to mean only known and scheduled planned outages that will occur or may continue into the planning horizon, is this interpretation consistent with the original interpretation by NERC of the standard as provided by NERC in response to industry questions in the Phase I development of this standard?*

**The following interpretation of TPL-002-0 and TPL-003-0 Requirement R1.3.12 was developed by the NERC Planning Committee on March 13, 2008:**

This provision was not previously interpreted by NERC since its approval by FERC and other regulatory authorities. TPL-002-0 and TPL-003-0 explicitly provide that the inclusion of planned (including

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maintenance) outages of any bulk electric equipment at demand levels for which the planned outages are required. For studies that include planned outages, compliance with the contingency assessment for TPL-002-0 and TPL-003-0 as outlined in Table 1 would include any necessary system adjustments which might be required to accommodate planned outages since a planned outage is not a “contingency” as defined in the *NERC Glossary of Terms Used in Standards*.

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**Appendix 2**

<b>Requirement Number and Text of Requirement</b>
<p><b>R1.3.</b> Be supported by a current or past study and/or system simulation testing that addresses each of the following categories, showing system performance following <b>Category B of Table 1</b> (single contingencies). The specific elements selected (from each of the following categories) for inclusion in these studies and simulations shall be acceptable to the associated Regional Reliability Organization(s).</p> <p style="padding-left: 40px;"><b>R1.3.10.</b> Include the effects of existing and planned protection systems, including any backup or redundant systems.</p>
<b>Background Information for Interpretation</b>
<p>Requirement R1.3 and sub-requirement R1.3.10 of standard TPL-002-0a contain three key obligations:</p> <ol style="list-style-type: none"> <li>1. That the assessment is supported by “study and/or system simulation testing that addresses each the following categories, showing system performance following Category B of Table 1 (single contingencies).”</li> <li>2. “...these studies and simulations shall be acceptable to the associated Regional Reliability Organization(s).”</li> <li>3. “Include the effects of existing and planned protection systems, including any backup or redundant systems.”</li> </ol> <p><i>Category B of Table 1 (single Contingencies) specifies:</i></p> <p>Single Line Ground (SLG) or 3-Phase (3Ø) Fault, with Normal Clearing:</p> <ol style="list-style-type: none"> <li>1. Generator</li> <li>2. Transmission Circuit</li> <li>3. Transformer</li> </ol> <p>Loss of an Element without a Fault.</p> <p>Single Pole Block, Normal Clearing<sup>e</sup>:</p> <ol style="list-style-type: none"> <li>4. Single Pole (dc) Line</li> </ol> <p><i>Note e specifies:</i></p> <p>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.</p> <p>The NERC Glossary of Terms defines Normal Clearing as “A protection system operates as designed and the fault is cleared in the time normally expected with proper functioning of the installed protection systems.”</p>
<b>Conclusion</b>
<p>TPL-002-0a requires that System studies or simulations be made to assess the impact of single Contingency operation with Normal Clearing. TPL-002-0a R1.3.10 does require that all elements</p>

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expected to be removed from service through normal operations of the Protection Systems be removed in simulations.

This standard does not require an assessment of the Transmission System performance due to a Protection System failure or Protection System misoperation. Protection System failure or Protection System misoperation is addressed in TPL-003-0 — System Performance following Loss of Two or More Bulk Electric System Elements (Category C) and TPL-004-0 — System Performance Following Extreme Events Resulting in the Loss of Two or More Bulk Electric System Elements (Category D).

TPL-002-0a R1.3.10 does not require simulating anything other than Normal Clearing when assessing the impact of a Single Line Ground (SLG) or 3-Phase (3Ø) Fault on the performance of the Transmission System.

**In regards to PacifiCorp’s comments on the material impact associated with this interpretation, the interpretation team has the following comment:**

Requirement R2.1 requires “a written summary of plans to achieve the required system performance,” including a schedule for implementation and an expected in-service date that considers lead times necessary to implement the plan. Failure to provide such summary may lead to noncompliance that could result in penalties and sanctions.