

## **TPL-002-AB-0 System Performance Following Loss of a Single BES Element**

### **1. Purpose**

The purpose of this *reliability standard* is to ensure that a reliable transmission system is planned that meets specified performance requirements with sufficient lead time. The transmission system must continue to be modified or upgraded as required to meet present and future system specified performance requirements as identified by periodically performed system simulations and associated planning assessments.

### **2. Applicability**

This *reliability standard* applies to:

- ISO

### **3. Definitions**

Italicized terms used in this *reliability standard* have the meanings as set out in the Alberta Reliability Standards Glossary of Terms and Part 1 of the ISO Rules.

### **4. Requirements**

**R1** The ISO must demonstrate for *transmission facilities* rated 69 kV and above, through a planning assessment, that a transmission system is planned such that the transmission system can be operated to accommodate forecasted customer *demands*, supply and forecasted 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 Appendix 1.

The ISO planning assessments must:

**R1.1** Be carried out annually.

**R1.2** Be conducted for near term (year one through five) and longer term (year six through ten) planning horizons.

**R1.3** Be supported by a study and/or system simulation testing, conducted within the last five years that addresses each of the requirements in requirement R1.3.1 to R1.3.12, showing system performance for the conditions defined in Category B of Appendix 1.

**R1.3.1** Be performed and evaluated only for those Category B *contingencies* that the ISO has determined would produce the more severe system results or impacts. The rationale for the *contingencies* selected for evaluation and an explanation of why the remaining simulations would produce less severe system results must be included in the study.

- R1.3.2** Cover critical system conditions and study years as determined necessary by the *ISO*.
- R1.3.3** Be conducted annually unless the *ISO* determines that changes to system conditions do not warrant such analyses.
- 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, if any.
- R1.3.6** Be performed and evaluated for selected *demand* levels over the range of forecast system *demands* as considered necessary by the *ISO*.
- R1.3.7** Demonstrate that system performance meets the conditions defined in Category B of Appendix 1.
- R1.3.8** Include existing and planned *facilities* as considered necessary by the *ISO*.
- 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 *outage* and maintenance of any bulk electric equipment (including *protection systems* or their components) at those *demand* levels for which planned (including maintenance) *outages* are performed. For stations supplied by two lines, if one line is out for maintenance, then those stations are considered to be supplied by a radial line.
- R1.4** Address any planned upgrades needed to meet the performance requirements for the conditions defined in Category B of Appendix 1.
- R1.5** Consider all *contingencies* applicable to Category B of Appendix 1.
- R2** When system simulations indicate an inability of the systems to respond as set out in R1.3.7 of this *reliability standard* the *ISO* must:
  - R2.1** Provide corrective 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 corrective 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 *ISO* must provide the planning assessment to *WECC* on an annual basis.

**5. Processes and Procedures**

No procedures have been defined for this *reliability standard*.

**6. Measures**

The following measures correspond to the requirements identified in Section 4 of this *reliability standard*. For example, MR1 is the measure for R1.

**MR1** The planning assessment will be valid and meet requirements in R1 through the following measures:

- The scope of the planning assessment identifies where area studies have been conducted in the past year. It also identifies area studies that have been conducted in previous years and are still valid. Where area studies have not been conducted, a plan and schedule to conduct one is included in the planning assessment.
- The planning assessment includes time horizons as specified in R1.2.
- The planning assessment has been prepared within the last year.
- A certification that the planning assessment complies with each of the R1 technical requirements is provided and states that the planning assessment meets all requirements, identifies requirements not met, and states reasons where the requirement was not met.
- A summary list of supporting area studies and needs identification documents is provided. The summary list includes the title and date of the study. The area studies and needs identification documents are provided if requested.

**MR2** The area studies and needs identification documents contain recommendations and projects for the corrective plans where an inability of the systems to respond to requirements specified in R1 has been identified. The area studies and needs identification documents must be provided on request.

**MR3** A written or email confirmation from *WECC* that it has received the planning assessment from the *ISO*. The confirmation includes the date of when the planning assessment was received and source identification information.

**7. Appendices**

**Appendix 1 - Transmission System Standards – Normal and Emergency Conditions**  
(see below)

**8. Guidelines**

No guidelines have been defined for this *reliability standard*.

**Revision History**

<b>Effective</b>	<b>Description</b>
0000-00-00	
0000-00-00	

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**Appendix 1 - 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 Transmission Service Transfers	Cascading
<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	Yes Yes Yes Yes	No <sup>b</sup> No <sup>b</sup> No <sup>b</sup> No <sup>b</sup>	No No No 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 2. Breaker (failure or internal fault)	Yes Yes	Planned/ Controlled <sup>c</sup> Planned/ Controlled <sup>c</sup>	No 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> : 5. Any two circuits of a multiple circuit towerline <sup>f</sup>	Yes Yes	Planned/ Controlled <sup>c</sup> Planned/ Controlled <sup>c</sup>	No No
	SLG fault, with delayed clearing <sup>e</sup> (stuck breaker or protection system failure) 6. Generator 7. Transformer	Yes Yes	Planned/ Controlled <sup>c</sup> Planned/ Controlled <sup>c</sup>	No 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) <i>elements</i> removed or <i>cascading</i> out of service</p>	<p>3Ø fault, with delayed clearing<sup>e</sup> (stuck breaker or <i>protection system</i> failure):</p> <p>1. Generator                      2. Transmission circuit</p> <p>3. Transformer                  4. Bus section</p>	<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 <i>interconnected</i> 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>
	<p>3Ø fault, with <i>normal clearing</i><sup>e</sup>:</p> <p>5. Breaker (failure or internal fault)</p>	
	<p>6. Loss of towerline with three or more circuits</p> <p>7. All transmission lines on a common right-of-way</p> <p>8. Loss of a substation (one voltage level plus transformers)</p> <p>9. Loss of a switching station (one voltage level plus transformers)</p> <p>10. Loss of all generating units at a station</p> <p>11. Loss of a large <i>load</i> or major <i>load</i> center</p> <p>12. Failure of a fully redundant <i>special protection system</i> (or <i>remedial action scheme</i>) to operate when required</p> <p>13. Operation, partial operation, or <i>misoperation</i> of a fully redundant <i>special protection system</i> (or <i>remedial action scheme</i>) in response to an event or abnormal system</p> <p>14. Impact of severe power swings or oscillations from disturbances in another Regional Reliability Organization</p>	

- a) Applicable *rating* refers to the applicable normal and emergency *facility* thermal and voltage *rating* as applied by the *facility* owner or system voltage limit as determined and consistently applied by the ISO. 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 by the applicable entity consistent with applicable ISO rules 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) transmission service 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) transmission service 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.

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- 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 (i.e., station entrance, river crossings) in accordance with exemption criteria.