

### Standard Development Roadmap

*This section is maintained by the drafting team during the development of the standard and will be removed when the standard becomes effective.*

#### Development Steps Completed:

1. The Standards Committee approved the SAR for posting on August 12, 2010.
2. SAR posted for formal comment on August 19, 2010.
3. Standard posted for informal comment period on August 19, 2010.
4. Attachment B (Applicability Test) of standard posted for informal comment period on September 23, 2010.
5. Standard with applicability test posted for 45-day formal comment period with concurrent ballot during the last 10 days of the comment period on November 1, 2010.

#### Proposed Action Plan and Description of Current Draft:

This is the ~~second~~third draft of the standard developed to address the FERC directives in Order No. 733 and is posted for a ~~45~~20-day ~~formal comment period with concurrent~~successive ballot ~~during the last 10 days of the comment~~ period.

#### Future Development Plan:

Anticipated Actions	Anticipated Date
1. Develop third draft of the standard and respond to comments-	December 2010 – January 2011
2. Conduct <u>successive ballot and</u> recirculation ballot of standard	January 2011- <u>February 2011</u>
3. <u>Submit to</u> NERC Board <u>of Trustees for</u> approval <u>to file</u>	February 2011
4. <u>Submit</u> <del>File</del> standard <del>to</del> <u>with</u> FERC for approval	March 2011

A. Introduction

1. Title: Transmission Relay Loadability

2. Number: PRC-023-2

3. Purpose: Protective relay settings shall not limit transmission loadability; not interfere with system operators' ability to take remedial action to protect system reliability and; be set to reliably detect all fault conditions and protect the electrical network from these ~~Faults~~faults.

4. Applicability:

4.1. Functional ~~Entities:~~Entity

4.1.1 Transmission Owners with load-responsive phase protection systems as described in PRC-023-2 - Attachment A, applied to ~~facilities~~circuits defined in 4.2.1 ~~through 4.2.6.~~(Circuits Subject to Requirements R1 – R5).

4.1.2 Generator Owners with load-responsive phase protection systems as described in PRC-023-2 - Attachment A, applied to ~~facilities~~circuits defined in 4.2.1 ~~through 4.2.6.~~(Circuits Subject to Requirements R1 – R5).

4.1.3 Distribution Providers with load-responsive phase protection systems as described in PRC-023-2 - Attachment A, applied ~~according to~~ facilities~~circuits~~ defined in 4.2.1 ~~through 4.2.6.~~(Circuits Subject to Requirements R1 – R5). provided those ~~facilities~~circuits have bi-directional flow capabilities.

4.1.4 Planning Coordinators

~~4.2. Facilities:~~

4.2. Circuits

4.2.1 Circuits Subject to Requirements R1 – R5

4.2.1.1 Transmission lines operated at 200 kV and above.

4.2.1.2 Transmission lines operated at 100 kV to 200 kV ~~that~~selected by the Planning Coordinator ~~has determined are required to comply with this standard.~~

4.2.1.3 Transmission lines operated below 100 kV that ~~Regional Entities have identified as~~ are included on a critical facilities ~~for~~list defined by the ~~purposes of~~ the Compliance RegistryRegional Entity<sup>1</sup> and selected by the Planning Coordinator ~~has determined are required to comply with this standard~~in accordance with R6.

FERC Order 733, ¶160: Apply an "add in" approach to sub-100 kV facilities.

4.2.1.4 Transformers with low voltage terminals connected at 200 kV and above.

4.2.1.5 Transformers with low voltage terminals connected at 100 kV to 200 kV ~~that~~selected by the Planning Coordinator ~~has determined are required to comply with this standard.~~

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<sup>1</sup>If the Regional Entity has developed such a list.

~~4.2.1.6~~ Transformers with low voltage terminals connected below 100 kV that ~~Regional Entities have identified as~~ are included on a critical facilities list defined by the purposes of the Compliance Registry Regional Entity and ~~selected by the Planning Coordinator has~~ determined are required to comply in accordance with this standard R6.

FERC Order 733, ¶284:  
Remove the exceptions  
footnote from the “Effective  
Dates” section.

#### 4.2.2 Circuits Subject to Requirement R6

4.2.2.1 Transmission lines operated at 100 kV to 200 kV and transformers with low voltage terminals connected at 100 kV to 200 kV

4.2.2.2 Transmission lines operated below 100 kV and transformers with low voltage terminals connected below 100 kV that are included on a critical facilities list defined by the Regional Entity

### 5. Effective Dates:

#### 5.1. Requirement R1: ~~the~~

5.1.1 For transmission lines operating at 200 kV and above and transformers with low voltage terminals connected at 200 kV and above.

5.1.1.1 ~~The~~ first day of the first calendar quarter after applicable regulatory ~~approvals~~ approval or in those jurisdictions where no regulatory approval is required, the first calendar quarter after Board of Trustees adoption, except as noted below.

5.1.1.1.1 For the addition to Requirement R1, criterion 10, to set transformer fault protection relays and transmission line relays on transmission lines terminated only with a transformer such that the protection settings do not expose the transformer to fault level and duration that exceeds its mechanical withstand capability, the first day of the first calendar quarter 12 months after applicable regulatory ~~approvals~~ approval, or in those jurisdictions where no regulatory approval is required, the first day of the first calendar quarter 12 months after Board of Trustees adoption.

5.1.1.1.2 For supervisory elements as described in PRC-023-2 - Attachment A, ~~section~~ Section 1.6, the first day of the first calendar quarter 24 months after applicable regulatory approvals, or in those jurisdictions where regulatory approval is not required, the first day of the first calendar quarter 24 months after Board of Trustees adoption.

5.1.1.1.3 ~~Requirements R2 and R3:~~ For switch-on-to-fault schemes as described in PRC-023-2 - Attachment A, Section 1.3, the ~~later of the~~ first day of the first calendar quarter after applicable regulatory ~~approvals~~ approval of PRC-023-2 or the first day of the first calendar quarter 39 months following applicable regulatory approval of PRC-023-1; or in those jurisdictions where no regulatory approval is required, the ~~later of the~~ first day of the first calendar quarter after Board of Trustees adoption of PRC-023-2 or July 1, 2011.

5.1.2 ~~Requirements R4 and R5: the first day of the first calendar quarter six months after applicable regulatory approvals or in those jurisdictions where no regulatory approval is required the first~~ For circuits identified by the Planning Coordinator pursuant to Requirement R6

~~5.2. The later of the first day of the first calendar quarter six~~<sup>39</sup> ~~months after Board of Trustees adoption.~~

~~5.2.1.15.1.2.1 Requirement R6: following notification by the Planning Coordinator of a circuit's inclusion on a list of circuits subject to PRC-023-2 per application of Attachment B, or the first day of the first calendar quarter 18 months after applicable regulatory approvals or in those jurisdictions where no regulatory approval is required the first day of the first calendar quarter 18 months after Board of Trustees adoption.~~ year in which any criterion in Attachment B applies.

**5.2. Requirement R7: the Requirements R2 and R3**

5.2.1 For transmission lines operating at 200 kV and above and transformers with low voltage terminals connected at 200 kV and above.

~~5.2.1.25.2.1.1 The~~ first day of the first calendar quarter after applicable regulatory approvals~~approval,~~ or in those jurisdictions where no regulatory approval is required, the first day of the first calendar quarter after Board of Trustees adoption.

5.2.2 For circuits identified by the Planning Coordinator pursuant to Requirement R6

5.2.2.1 The later of the first day of the first calendar quarter 39 months following notification by the Planning Coordinator of a circuit's inclusion on a list of circuits subject to PRC-023-2 per application of Attachment B, or the first day of the first calendar year in which any criterion in Attachment B applies.

**5.3. Requirements R4 and R5**

The first day of the first calendar quarter six months after applicable regulatory approval, or in those jurisdictions where no regulatory approval is required, the first day of the first calendar quarter six months after Board of Trustees adoption.

**5.4. Requirement R6**

The first day of the first calendar quarter 18 months after applicable regulatory approval, or in those jurisdictions where no regulatory approval is required, the first day of the first calendar quarter 18 months after Board of Trustees adoption.

**B. Requirements**

**R1.** Each Transmission Owner, Generator Owner, and Distribution Provider shall use any one of the following criteria (Requirement R1, criteria 1 through 13) for any specific circuit terminal to prevent its phase protective relay settings from limiting transmission system loadability while maintaining reliable protection of the BES for all fault conditions. Each Transmission Owner, Generator Owner, and Distribution Provider shall evaluate relay loadability at 0.85 per unit voltage and a power factor angle of 30 degrees. [*Violation Risk Factor: High*] [*Mitigation Time Horizon: Long Term Planning*].

**Criteria:**

1. Set transmission line relays so they do not operate at or below 150% of the highest seasonal Facility Rating of a circuit, for the available defined loading duration nearest 4 hours (expressed in amperes).

2. Set transmission line relays so they do not operate at or below 115% of the highest seasonal 15-minute Facility Rating<sup>2</sup> of a circuit (expressed in amperes).
3. Set transmission line relays so they do not operate at or below 115% of the maximum theoretical power transfer capability (using a 90-degree angle between the sending-end and receiving-end voltages and either reactance or complex impedance) of the circuit (expressed in amperes) using one of the following to perform the power transfer calculation:
  - An infinite source (zero source impedance) with a 1.00 per unit bus voltage at each end of the line.
  - An impedance at each end of the line, which reflects the actual system source impedance with a 1.05 per unit voltage behind each source impedance.
4. Set transmission line relays on series compensated transmission lines so they do not operate at or below the maximum power transfer capability of the line, determined as the greater of:
  - 115% of the highest emergency rating of the series capacitor.
  - 115% of the maximum power transfer capability of the circuit (expressed in amperes), calculated in accordance with Requirement R1, criterion 3, using the full line inductive reactance.
5. Set transmission line relays on weak source systems so they do not operate at or below 170% of the maximum end-of-line three-phase fault magnitude (expressed in amperes).
6. Set transmission line relays applied on transmission lines connected to generation stations remote to load so they do not operate at or below 230% of the aggregated generation nameplate capability.
7. Set transmission line relays applied at the load center terminal, remote from generation stations, so they do not operate at or below 115% of the maximum current flow from the load to the generation source under any system configuration.
8. Set transmission line relays applied on the bulk system-end of transmission lines that serve load remote to the system so they do not operate at or below 115% of the maximum current flow from the system to the load under any system configuration.
9. Set transmission line relays applied on the load-end of transmission lines that serve load remote to the bulk system so they do not operate at or below 115% of the maximum current flow from the load to the system under any system configuration.
10. Set transformer fault protection relays and transmission line relays on transmission lines terminated only with a transformer ~~such that the protection settings do not expose the transformer to fault level and duration that exceeds its mechanical withstand capability and~~ so that the relays do not operate at or below the greater of:

FERC Order 733, ¶203: Modify sub-requirement R1.10 to verify equipment is capable of sustaining the anticipated overload associated with the fault.

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<sup>2</sup> When a 15-minute rating has been calculated and published for use in real-time operations, the 15-minute rating can be used to establish the loadability requirement for the protective relays.

- 150% of the applicable maximum transformer nameplate rating (expressed in amperes), including the forced cooled ratings corresponding to all installed supplemental cooling equipment.
- 115% of the highest operator established emergency transformer rating~~-~~.

**10.1** Set load responsive transformer fault protection relays, if used, such that the protection settings do not expose the transformer to a fault level and duration that exceeds the transformer's mechanical withstand capability<sup>3</sup>.

- 11.** For transformer overload protection relays that do not comply with the loadability component of Requirement R1, criterion 10 set the relays according to one of the following:
- Set the relays to allow the transformer to be operated at an overload level of at least 150% of the maximum applicable nameplate rating, or 115% of the highest operator established emergency transformer rating, whichever is greater, for at least 15 minutes to provide time for the operator to take controlled action to relieve the overload.
  - Install supervision for the relays using either a top oil or simulated winding hot spot temperature element set no less than 100° C for the top oil temperature or no less than 140° C for the winding hot spot temperature<sup>4</sup>.
- 12.** When the desired transmission line capability is limited by the requirement to adequately protect the transmission line, set the transmission line distance relays to a maximum of 125% of the apparent impedance (at the impedance angle of the transmission line) subject to the following constraints:
- a. Set the maximum torque angle (MTA) to 90 degrees or the highest supported by the manufacturer.
  - b. Evaluate the relay loadability in amperes at the relay trip point at 0.85 per unit voltage and a power factor angle of 30 degrees.
  - c. Include a relay setting component of 87% of the current calculated in Requirement R1, criterion 12 in the Facility Rating determination for the circuit.
- 13.** Where other situations present practical limitations on circuit capability, set the phase protection relays so they do not operate at or below 115% of such limitations.

- R2.** Each Transmission Owner, Generator Owner, and Distribution Provider shall ~~verify that~~ set its out-of-step blocking elements to allow tripping of phase protective relays for faults that occur during the loading conditions used to verify transmission line relay loadability per Requirement R1. *[Violation Risk Factor: High] [Time Horizon: Long Term Planning]*

**FERC Order 733, ¶244: Include section 2 of Appendix A as an additional Requirement.**

<sup>3</sup> As illustrated by the “dotted line” in IEEE C57.109-1993 - *IEEE Guide for Liquid-Immersed Transformer Through-Fault-Current Duration*, Clause 4.4, Figure 4

<sup>4</sup> IEEE standard C57.115, Table 3, specifies that transformers are to be designed to withstand a winding hot spot temperature of 180 degrees C, and cautions that bubble formation may occur above 140 degrees C.

**R3.** Each Transmission Owner, Generator Owner, and Distribution Provider that uses a circuit capability with the practical limitations described in Requirement R1, criterion 6, 7, 8, 9, 12, or 13 shall use the calculated circuit capability as the Facility Rating of the circuit and shall obtain the agreement of the Planning Coordinator, Transmission Operator, and Reliability Coordinator with the calculated circuit capability. *[Violation Risk Factor: Medium] [Time Horizon: Long Term Planning]*

**R4.** Each Transmission Owner, Generator Owner, and Distribution Provider that chooses to use Requirement R1 criterion 2 as the basis for verifying transmission line relay loadability shall provide its Planning Coordinator, Transmission Operator, and Reliability Coordinator with ~~an~~ updated list of ~~facilities~~circuits associated with those transmission line relays at least once each calendar year, with no more than 15 months between reports. *[Violation Risk Factor: Lower] [Time Horizon: Long Term Planning]*

FERC Order 733, ¶186: Modify R1.2 to require that TOs, GOs, and DPs give their TOPs a list of transmission facilities that implement R1.2.

**R5.** Each Transmission Owner, Generator Owner, and Distribution Provider that sets transmission line relays according to Requirement R1 criterion 12 shall provide ~~an~~ updated list of the ~~facilities~~circuits associated with those relays to its Regional Entity at least once each calendar year, with no more than 15 months between reports, to allow ~~entire~~the ERO to ~~know which facilities compile a list of all circuits that~~ have protective relay settings that limit the facility's circuit capability. *[Violation Risk Factor: Lower] [Time Horizon: Long Term Planning]*

FERC Order 733, ¶224: Make available for review to users, owners and operators of the Bulk Power System, by request, a list of those facilities that have protective relays set pursuant sub-requirement R1.12 of anticipated overload.

**R6.** Each Planning Coordinator shall ~~apply the criteria in Attachment B to conduct~~ an assessment conducted at least once each calendar year, with no more than 15 months between assessments, ~~to by applying the criteria in Attachment B to~~ determine the circuits in its Planning Coordinator area for which transmission Elements Transmission Owners, Generator Owners, and Distribution Providers must comply with ~~this standard~~Requirements R1 through R5. The Planning Coordinator shall: *[Violation Risk Factor: High] [Time Horizon: Long Term Planning]*

~~6.1~~ — Apply the criteria to transmission lines that are operated at 100 kV to 200 kV and transformers with low voltage terminals connected at 100 kV to 200 kV.

~~6.2~~ — Apply the criteria to transmission lines operated below 100 kV and transformers with low voltage terminal connections below 100 kV, if the Regional Entity has identified either of these Element types as critical facilities for the purposes of the Compliance Registry and they are in its Planning Coordinator Area.

~~6.3~~ — Maintain a list of ~~facilities determined according to the process described in Requirement R6.~~

~~6.46.1~~ Include on the list the circuits subject to PRC-023-2 per application of Attachment B, including identification of the first calendar year studied for in which any criterion B4 in Attachment B first applies when a facility is added and only criterion B4 is applicable applies.

FERC Order 733, ¶237: Modify sub-requirement R3.3 to add the RE to list of entities that receive the critical facilities list.

~~6.56.2~~ Provide the list of facilities circuits to all Regional Entities, Reliability Coordinators, Transmission Owners, Generator Owners, and Distribution Providers

within its Planning Coordinator ~~Area~~ within 30 calendar days of the establishment of the initial list and within 30 calendar days of any changes to that list.

~~R7. Each Transmission Owner, Generator Owner, and Distribution Provider shall implement Requirement R1, Requirement R2, Requirement R3, Requirement R4, and Requirement R5 for each facility that is added to the Planning Coordinator's list of facilities that must comply with this standard pursuant to Requirement R6, Part 6.5 by the later of the first day of the second calendar quarter 24 months following notification by the Planning Coordinator of a facility's inclusion on such a list or the first day of the first calendar quarter of the year in which Attachment B criterion B4 first applies. [Violation Risk Factor: High] [Time Horizon: Long Term Planning]~~

### C. Measures

- M1. ~~The~~Each Transmission Owner, Generator Owner, and Distribution Provider shall have evidence such as spreadsheets or summaries of calculations to show that each of its transmission relays is set according to one of the criteria in Requirement R1, criterion 1 through 13 and shall have evidence such as coordination curves or summaries of calculations that show that relays set per criterion 10 do not expose the transformer to fault levels and durations beyond those indicated in the standard. (R1)
- M2. ~~The~~Each Transmission Owner, Generator Owner, and Distribution Provider shall have evidence such as spreadsheets or summaries of calculations to show that each of its out-of-step blocking elements ~~allows~~ is set to allow tripping of phase protective relays for faults that occur during the loading conditions used to verify transmission line relay loadability per Requirement R1. (R2)
- M3. ~~The~~Each Transmission Owner, Generator Owner, and Distribution Provider with transmission relays set according to Requirement R1, criterion 6, 7, 8, 9, 12, or 13 shall have evidence such as Facility Rating spreadsheets or Facility Rating database to show that ~~they~~ it used the calculated circuit capability as the Facility Rating of the circuit and evidence such as dated correspondence that the resulting Facility Rating was agreed to by its associated Planning Coordinator, Transmission Operator, and Reliability Coordinator. (R3)
- M4. ~~The~~Each Transmission Owner, Generator Owner, or Distribution Provider that sets transmission line relays according to Requirement R1, criterion 2 shall have evidence such as dated correspondence to show that ~~they~~ it provided its Planning Coordinator, Transmission Operator, and Reliability Coordinator with ~~an updated~~ list of ~~facilities~~ circuits associated with those transmission line relays within the required timeframe. The updated list may either be a full list or a list of incremental changes to the previous list. (R4)
- M5. ~~The~~Each Transmission Owner, Generator Owner, or Distribution Provider that sets transmission line relays according to Requirement R1, criterion 12 shall have evidence such as dated correspondence that it provided ~~an updated~~ list of the ~~facilities~~ circuits associated with those relays to its Regional Entity within the required timeframe. The updated list may either be a full list or a list of incremental changes to the previous list. (R5)
- M6. ~~The~~Each Planning Coordinator shall have evidence such as power flow results, calculation summaries, or study reports that ~~they~~ it used the criteria established within Attachment B to determine the ~~facilities that~~ circuits in its Planning Coordinator area for which applicable entities must comply with ~~this~~ the standard as described in Requirement R6. The Planning Coordinator shall have a dated list of such ~~facilities~~ circuits and shall have evidence such as dated correspondence that it provided the list to the Regional Entities, Reliability Coordinators, Transmission Owners, Generator Owners, and Distribution Providers within its Planning Coordinator ~~Area~~ area within the required timeframe. (R6)



~~M7. The Transmission Owner, Generator Owner, and Distribution Provider shall have evidence such as dated spreadsheets, summaries of calculations, and study reports, that it implemented the Requirements within the specified timeframe per Requirement R7.~~

## D. Compliance

### 1. Compliance Monitoring Process

#### 1.1. Compliance Monitoring Responsibility

##### ~~Regional Entity~~

- For entities that do not work for the Regional Entity, the Regional Entity shall serve as the Compliance Enforcement Authority.
- For functional entities that work for their Regional Entity, the ERO shall serve as the Compliance Enforcement Authority.

#### 1.2. Data Retention

The Transmission Owner, Generator Owner, Distribution Provider and Planning Coordinator shall keep data or evidence to show compliance as identified below unless directed by its Compliance Enforcement Authority to retain specific evidence for a longer period of time as part of an investigation:

The Transmission Owner, Generator Owner, and Distribution Provider shall each retain documentation to demonstrate compliance with Requirements R1 through R5 ~~and R7~~ for three calendar years.

The Planning Coordinator shall retain documentation of the most recent review process required in R6. The Planning Coordinator shall retain the most recent list of ~~facilities that are critical to the reliability of the electric system~~ circuits in its Planning Coordinator area for which applicable entities must comply with the standard, as determined per R6.

If a Transmission Owner, Generator Owner, Distribution Provider or Planning Coordinator is found non-compliant, it shall keep information related to the non-compliance until found compliant or for the time specified above, whichever is longer.

The Compliance Monitor shall keep the last audit record and all requested and submitted subsequent audit records.

#### 1.3. Compliance Monitoring and Assessment Processes

- Compliance Audit
- Self-Certification
- Spot Checking
- Compliance Violation Investigation
- Self-Reporting
- Complaint

#### 1.4. Additional Compliance Information

None.

2. Violation Severity Levels:

Requirement	Lower	Moderate	High	Severe
<b>R1</b>	N/A	N/A	N/A	<p>The responsible entity did not use any one of the following criteria (Requirement R1 criterion 1 through 13) for any specific circuit terminal to prevent its phase protective relay settings from limiting transmission system loadability while maintaining reliable protection of the Bulk Electric System for all fault conditions.</p> <p>OR</p> <p>The responsible entity did not evaluate relay loadability at 0.85 per unit voltage and a power factor angle of 30 degrees.</p>
<b>R2</b>	N/A	N/A	N/A	<p>The responsible entity failed to ensure that its out-of-step blocking elements allowed tripping of phase protective relays for faults that occur during the loading conditions used to verify transmission line relay loadability per Requirement R1.</p>
<b>R3</b>	N/A	N/A	N/A	<p>The responsible entity that uses a circuit capability with the practical limitations described in Requirement R1 criterion 6, 7, 8, 9, 12, or 13 did not use the calculated circuit capability as the Facility Rating of the circuit.</p> <p>OR</p>

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Requirement	Lower	Moderate	High	Severe
				The responsible entity did not obtain the agreement of the Planning Coordinator, Transmission Operator, and Reliability Coordinator with the calculated circuit capability.
R4	N/A	N/A	N/A	The responsible entity did not provide its Planning Coordinator, Transmission Operator, <b>Regional Entity</b> , and Reliability Coordinator with <b>aan updated</b> list of <b>facilitiescircuits</b> that have transmission line relays set according to the criteria established in Requirement R1 criterion 2 at least once each calendar year, with no more than 15 months between reports.
R5	N/A	N/A	N/A	The responsible entity did not provide its Regional Entity, with <b>aan updated</b> list of <b>faelitiescircuits</b> that have transmission line relays set according to the criteria established in Requirement R1 criterion 12 at least once each calendar year, with no more than 15 months between reports.
R6	N/A	The Planning Coordinator used the criteria established within Attachment B to determine <b>which transmission Elements, described in 6.1 and 6.2, the circuits</b> in its Planning Coordinator area <b>for which applicable entities</b> must comply with the standard and met parts <b>6.3 through 1 and 6.52</b> , but more than 15 months and less than	The Planning Coordinator used the criteria established within Attachment B to determine <b>which transmission Elements, described in 6.1 and 6.2, the circuits</b> in its Planning Coordinator area <b>for which applicable entities</b> must comply with the standard and met parts <b>6.3 through 1 and 6.52</b> , but 24 months or more lapsed between	The Planning Coordinator failed to use the criteria established within Attachment B to determine <b>which transmission Elements, described in 6.1 and 6.2, the circuits</b> in its Planning Coordinator area <b>for which applicable entities</b> must comply with the standard. OR

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Requirement	Lower	Moderate	High	Severe
		<p>24 months lapsed between assessments.</p> <p>OR</p> <p>The Planning Coordinator used the criteria established within Attachment B at least once each calendar year, with no more than 15 months between assessments to determine <del>which transmission Elements, described in 6.1 and 6.2,</del>the circuits in its Planning Coordinator area <u>for which applicable entities</u> must comply with the standard and met 6.31 and 6.52 but failed to include the <u>calendar year studied for</u>in which <u>any</u> criterion <del>B4</del> in Attachment B first applies <del>when a facility is added and only criterion B4 is applicable (part 6.4).</del></p> <p>OR</p> <p>The Planning Coordinator used the criteria established within Attachment B at least once each calendar year, with no more than 15 months between assessments to determine <del>which transmission Elements, described in 6.1 and 6.2,</del>the circuits in its Planning Coordinator area <u>for which applicable entities</u> must comply with the standard and met 6.31 and 6.42 but provided the list of <del>facilities</del>circuits to the Reliability Coordinators, Transmission Owners, Generator Owners, and</p>	<p>assessments.</p> <p>OR</p> <p>The Planning Coordinator used the criteria established within Attachment B at least once each calendar year, with no more than 15 months between assessments to determine <del>which transmission Elements, described in 6.1 and 6.2,</del>the circuits in its Planning Coordinator area <u>for which applicable entities</u> must comply with the standard and met 6.31 and 6.42 but provided the list of <del>facilities</del>circuits to the Reliability Coordinators, Transmission Owners, Generator Owners, and Distribution Providers within its Planning Coordinator <del>Area</del> <u>within area between</u> 46 days and 60 days after list was established or updated. (part 6.5)-2)</p>	<p>The Planning Coordinator used the criteria established within Attachment B, at least once each calendar year, with no more than 15 months between assessments; to determine <del>which transmission Elements, described in 6.1 and 6.2,</del>the circuits in its Planning Coordinator area <u>for which applicable entities</u> must comply with the standard but failed to meet parts 6.3, 6.41 and 6.52.</p> <p>OR</p> <p>The Planning Coordinator used the criteria established within Attachment B, at least once each calendar year, with no more than 15 months between assessments; to determine <del>which transmission Elements</del>the circuits in its Planning Coordinator area <u>for which applicable entities</u> must comply with the standard but failed to <del>apply the criteria</del><u>maintain the list of circuits determined according</u> to the <del>Elements</del>process described in <del>parts</del><u>Requirement R6.</u> (part 6.1 and 6.2.)</p> <p>OR</p> <p>The Planning Coordinator used the criteria established within Attachment B at least once each calendar year, with no more than 15 months between assessments to determine <del>which transmission Elements, described in 6.1 and 6.2,</del>the circuits in its Planning</p>

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Requirement	Lower	Moderate	High	Severe
		<p>Distribution Providers within its Planning Coordinator <del>Area within 31 days area between 31 days and 45 days</del> after the list was established or updated. (part 6.5)-2)</p>		<p>Coordinator area <del>for which applicable entities</del> must comply with the standard and met 6.4 and 6.5 but failed to maintain the list of facilities determined according to the process described in Requirement R6 (part 6.3).</p> <p>OR</p> <p>The Planning Coordinator used the criteria established within Attachment B at least once each calendar year, with no more than 15 months between assessments to determine which transmission Elements, described in 6.1 and 6.2, in its Planning Coordinator area must comply with the standard and met 6.3 and 6.4 but failed to provide the list of <del>facilities</del> circuits to the Reliability Coordinators, Transmission Owners, Generator Owners, and Distribution Providers within its Planning Coordinator <del>Area area</del> or provided the list more than 60 days after the list was established or updated. (part 6.5)-2)</p>
R7	N/A	N/A	N/A	<p>The Transmission Owner, Generator Owner, or Distribution Provider failed to implement Requirement R1, Requirement R2, Requirement R3, Requirement R4, and Requirement R5 for each facility that is added to the Planning Coordinator's list of facilities that must comply with this standard pursuant to Requirement R6, Part 6.5 by the</p>

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Requirement	Lower	Moderate	High	Severe
				<p><del>later of the first day of the second calendar quarter after 24 months following notification by the Planning Coordinator of a facility's inclusion on such a list by the Planning Coordinator or the first day of the first calendar quarter of the year in which Attachment B criterion B4 first applies.</del></p>

**E. Regional Differences**

None

**F. Supplemental Technical Reference Document**

1. The following document is an explanatory supplement to the standard. It provides the technical rationale underlying the requirements in this standard. The reference document contains methodology examples for illustration purposes it does not preclude other technically comparable methodologies

“Determination and Application of Practical Relaying Loadability Ratings,” Version 1.0, January 9, 2007, prepared by the System Protection and Control Task Force of the NERC Planning Committee, available at: <http://www.nerc.com/~filez/reports.html>.

**Version History**

<b>Version</b>	<b>Date</b>	<b>Action</b>	<b>Change Tracking</b>
1	February 12, 2008	Approved by Board of Trustees	New
1	March 19, 2008	Corrected typo in last sentence of Severe VSL for Requirement 3 — “then” should be “than.”	Errata
1	March 18, 2010	Approved by FERC	
2	November 1, 2010	Revised to address directives from Order 733	
<u>2</u>	<u>January 14, 2011</u>	<u>Revised to address formal industry comments</u>	

**PRC-023 — Attachment A**

1. This standard includes any protective functions which could trip with or without time delay, on load current, including but not limited to:
  - 1.1. Phase distance.
  - 1.2. Out-of-step tripping.
  - 1.3. Switch-on-to-fault.
  - 1.4. Overcurrent relays.
  - 1.5. Communications aided protection schemes including but not limited to:
    - 1.5.1 Permissive overreach transfer trip (POTT).
    - 1.5.2 Permissive under-reach transfer trip (PUTT).
    - 1.5.3 Directional comparison blocking (DCB).
    - 1.5.4 Directional comparison unblocking (DCUB).
  - 1.6. Supervisory elements associated with current-based, communication-assisted schemes where the scheme is capable of tripping for loss of communications.
2. The following protection systems are excluded from requirements of this standard:
  - 2.1. Relay elements that are only enabled when other relays or associated systems fail. For example:
    - Overcurrent elements that are only enabled during loss of potential conditions.
    - Elements that are only enabled during a loss of communications except as noted in section 1.6
  - 2.2. Protection systems intended for the detection of ground fault conditions.
  - 2.3. Protection systems intended for protection during stable power swings.
  - 2.4. Generator protection relays that are susceptible to load.
  - 2.5. Relay elements used only for Special Protection Systems applied and approved in accordance with NERC Reliability Standards PRC-012 through PRC-017 or their successors.
  - 2.6. Protection systems that are designed only to respond in time periods which allow 15 minutes or greater to respond to overload conditions.
  - 2.7. Thermal emulation relays which are used in conjunction with dynamic Facility Ratings.
  - 2.8. Relay elements associated with dc lines.
  - 2.9. Relay elements associated with dc converter transformers.

FERC Order 733, ¶264: Revise section 1 of Attachment A to include supervising relay elements.



PRC-023 — Attachment B

**Criteria**

Review each applicable circuit against the criteria in this Attachment to determine the facilities that must comply with the standard.

Applicable circuits include:

**Circuits to Evaluate**

- Transmission lines operated at 100 kV to 200 kV and transformers with low voltage terminals connected at 100 kV to 200 kV.
- ~~Transmission lines~~ Lines operated below 100 kV and transformers with low voltage terminals connected below 100 kV that ~~Regional Entities have identified as~~ are included on a critical facilities ~~for list defined by the purposes of the Compliance Registry~~ Regional Entity.

**Criteria**

If any of the following criteria apply to a circuit, the ~~circuit~~ applicable entity must comply with the standard ~~for that circuit~~.

- B1. ~~Each~~The circuit ~~that~~ is a monitored ~~Element~~ Facility of a ~~permanent~~ flowgate in the Eastern Interconnection, a major transfer path within the Western Interconnection as defined by the Regional Entity, or a comparable monitored ~~Element~~ Facility in the ~~Texas Interconnection or~~ Québec Interconnection, that has been included to address ~~long-term~~ reliability concerns ~~for loading of that circuit~~, as confirmed by the applicable Planning Coordinator.
- B2. ~~Each~~The circuit ~~that~~ is a monitored ~~Element~~ Facility of an IROL, where the IROL was determined in the ~~long-term~~ planning horizon ~~pursuant to FAC-010~~.
- B3. ~~Each~~The circuit ~~that~~ forms a path (as agreed to by the plant owner and the ~~Transmission Entity~~ transmission entity) to supply off-site power to a nuclear ~~plants~~ plant as established in the Nuclear Plant Interface Requirements (NPIRs) pursuant to NUC-001.
- B4. ~~Each~~The circuit is identified through the following ~~sequence of~~ power flow ~~analysis~~ analyses<sup>5</sup> performed by the Planning Coordinator for the one-to-five-year planning horizon:
  - a. Simulate double contingency combinations selected by engineering judgment ~~in TPL-003 Category C3, but~~, without manual system adjustments in between ~~the two contingencies~~ (reflects a situation where a System Operator may not have time between the two contingencies to make appropriate system adjustments).
  - b. For circuits operated between 100 kV and 200 kV evaluate the post-contingency loading, ~~in consultation with the Facility owner~~, against a threshold based on the Facility Rating assigned for that circuit and used in the power flow case by the Planning Coordinator.

FERC Order 733, ¶69: Specify the test that PCs must use to determine whether sub-200 kV facility is critical to reliability of the BES

<sup>5</sup> Past analyses may be used to support the assessment if no material changes to the system have occurred since the last assessment

- c. When more than one Facility Rating for that circuit is available in the power flow case, the threshold for selection will be based on the Facility Rating for the loading duration nearest four hours.
- d. The threshold for selection ~~as a of the~~ circuit ~~that must comply with the standard~~ will vary based on the loading duration assumed in the development of the Facility Rating.
  - i. If the Facility Rating is based on a loading duration of up to and including four hours, the circuit must comply with the standard if the loading exceeds 115% of the Facility Rating.
  - ii. If the Facility Rating is based on a loading duration greater than four and up to and including eight hours, the circuit must comply with the standard if the loading exceeds 120% of the Facility Rating.
  - iii. If the Facility Rating is based on a loading duration of greater than eight hours, the circuit must comply with the standard if the loading exceeds 130% of the Facility Rating.
- e. ~~Radial~~Radially operated circuits serving only load are excluded.

**B5.** ~~Each~~The circuit ~~that is selected by~~ the Planning Coordinator ~~may include~~ based on ~~other~~ technical studies or assessments ~~-, other than those specified in criteria B1 through B4, in consultation with the Facility owner.~~

**B6.** The circuit is mutually agreed upon for inclusion by the Planning Coordinator and the Facility owner.