Introduction

1. Title: Transmission System Planning Performance
2. Number: TPL-001-WECC-CRT-3.2
3. Purpose: To facilitate coordinated near-term and long-term transmission planning within the Interconnection of the Western Electricity Coordinating Council (WECC), and to facilitate the exchange of the associated planning information for normal and abnormal conditions.

This document applies to all transmission planning studies conducted within the Interconnection of the Western Electricity Coordinating Council (WECC).

This is a planning criterion. This document does not designate the entity responsible for system remediation.

4. Applicability:
   4.1. Functional Entities:
       4.1.1. Planning Coordinator
       4.1.2. Transmission Planner
   4.2. Facilities
       4.2.1. This document applies to Bulk Electric System (BES) Facilities.
       4.2.2. The following buses are specifically excluded from this WECC Criterion:
           4.2.2.1. Non-BES buses,
           4.2.2.2. Line side series capacitor buses,
           4.2.2.3. Line side series reactor buses,
           4.2.2.4. Dedicated shunt capacitor buses,
           4.2.2.5. Dedicated shunt reactor buses,
           4.2.2.6. Metering buses, fictitious buses, or other buses that model point of interconnection solely for measuring electrical quantities; and
4.2.2.7. Other buses specifically excluded by each Planning Coordinator or Transmission Planner internal to its system.

5. Effective Date: June 18, 2019
Requirements and Measures

WR1. Each Transmission Planner and Planning Coordinator shall use the following default base planning criteria, unless otherwise specified in accordance with Requirements WR2 and WR3:

1.1. Steady-state voltages at all applicable Bulk-Electric System (BES) buses shall stay within each of the following limits:

   1.1.1. 95 percent to 105 percent of nominal for P0\(^1\) event (system normal pre-contingency event powerflow);

   1.1.2. 90 percent to 110 percent of nominal for P1-P7\(^2\) events (post-contingency event powerflow).

1.2. Post-Contingency steady-state voltage deviation at each applicable BES bus serving load shall not exceed 8 percent for P1 events.

1.3. Following fault clearing, the voltage shall recover to 80 percent of the pre-contingency voltage within 20 seconds of the initiating event for all P1 through P7 events, for each applicable BES bus serving load.

1.4. Following fault clearing and voltage recovery above 80 percent, voltage at each applicable BES bus serving load shall neither dip below 70 percent of pre-contingency voltage for more than 30 cycles nor remain below 80 percent of pre-contingency voltage for more than two seconds, for all P1 through P7 events.

1.5. For Contingencies without a fault (P2.1 category event), voltage dips at each applicable BES bus serving load shall neither dip below 70 percent of pre-contingency voltage for more than 30 cycles nor remain below 80 percent of pre-contingency voltage for more than two seconds.

1.6. All oscillations that do not show positive damping within 30-seconds after the start of the studied event shall be deemed unstable.

WM1. Each Transmission Planner and Planning Coordinator will have evidence that it used the base criteria in its Planning Assessment specified in Requirement WR1, unless otherwise allowed in accordance with Requirements WR2 and WR3.

WR2. Each Transmission Planner and Planning Coordinator that uses a more stringent criterion than that stated in Requirement WR1 shall apply that criterion only to its own system, except

1 P0 through P7 refers to the categories of contingencies identified in Table 1 of NERC Standard TPL-001-4, Transmission System Planning Performance Requirements.

2 Previously cited
where otherwise agreed upon by all other planning entities to which the more stringent criterion was applied.

**WM2.** Each Transmission Planner and Planning Coordinator that uses a more stringent criterion in its planning assessment than that stated in Requirement WR1 and applied that criterion to other systems will have evidence of agreement from all other planning entities to which the more stringent criterion was applied.

**WR3.** Each Transmission Planner and Planning Coordinator that uses a less stringent criterion than that stated in Requirement WR1 shall allow other Transmission Planners and Planner Coordinators to have the same impact on that part of the system for the same category of planning events (e.g., P1, P2).

**WM3.** Each Transmission Planner and Planning Coordinator that uses a less stringent criterion than that stated in Requirement WR1 will have evidenced that it allowed other Transmission Planners and Planner Coordinators to have the same impact on that part of the system for the same category of planning events (e.g., P1, P2).

**WR4.** Each Transmission Planner and Planning Coordinator shall use the following threshold criteria to identify the potential for Cascading or uncontrolled islanding. An entity can use these criteria to identify instability due to Cascading or uncontrolled islanding if it does not impose it on others:

- When a post contingency analysis results in steady-state facility loading that is either more than a known BES facility trip setting, or exceeds 125 percent of the highest seasonal facility rating for the BES facility studied. If the trip setting is known to be different than the 125 percent threshold, the known setting should be used.

- When transient stability voltage response occurs at any applicable BES bus outside of the criteria stated in Requirement WR1.3 of this document.

- When either unrestrained successive load loss occurs or unrestrained successive generation loss occurs.

**WM4.** Each Transmission Planner and Planning Coordinator will have evidence that it used the indicators of Requirement WR4 to identify the potential for Cascading or uncontrolled islanding.

**WR5.** Each Transmission Planner and Planning Coordinator shall use the following minimum criteria when identifying voltage stability:

5.1. For transfer paths, all P0-P1 events shall demonstrate a positive reactive power margin at a minimum of 105 percent of transfer path flow.
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5.2. For transfer paths, all P2-P7 events shall demonstrate a positive reactive power margin at a minimum of 102.5 percent of transfer path flow.

5.3. For load areas, all P0-P1 events shall demonstrate a positive reactive power margin at a minimum of 105 percent of forecasted peak load.

5.4. For load areas, all P2-P7 events shall demonstrate a positive reactive power margin at a minimum of 102.5 percent of forecasted peak load.

WM5. Each Transmission Planner and Planning Coordinator will have evidenced that it used the minimum criteria identified in Requirement WR5 to identify voltage stability.

WR6. Each Transmission Planner and Planning Coordinator that uses study criteria different from the base criteria in Requirement WR1 shall make its criteria available upon request within 30 days.

WM6. Each Transmission Planner and Planning Coordinator that uses study criteria different from the base criteria in Requirement WR1 will have evidence that it made its criteria available upon request, as required in Requirement WR6.
## Version History

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Action</th>
<th>Change Tracking</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>March 6, 2008</td>
<td>WECC Planning Coordination Committee (PCC) approved</td>
<td>Reliability Subcommittee translates existing WECC components of NERC/WECC Planning Standards into a CRT.</td>
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<tr>
<td></td>
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<td>TPL-(001 thru 004)-WECC-1-CR.</td>
<td></td>
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<tr>
<td>1</td>
<td>April 16, 2008</td>
<td>WECC Board of Directors (Board) approved</td>
<td>No substantive changes</td>
</tr>
<tr>
<td>2</td>
<td>October 13, 2011</td>
<td>PCC approves</td>
<td>Clarifies “corridor”</td>
</tr>
<tr>
<td>2</td>
<td>December 1, 2011</td>
<td>Board approved</td>
<td>No substantive change</td>
</tr>
<tr>
<td>2</td>
<td>September 5, 2012</td>
<td>Board changed designation</td>
<td>Approved a nomenclature change from “CRT” to “RBP”</td>
</tr>
<tr>
<td>2.1</td>
<td>August 6, 2013</td>
<td>Errata</td>
<td>WM2 Measure moved to WM3. WM3 Measure moved to WM4. WM4 Measure moved to WM2.</td>
</tr>
<tr>
<td>2.1</td>
<td>December 5, 2013</td>
<td>Board approved</td>
<td>Developed as WECC-0100, on October 8, 2013, the Ballot Pool retired WR1, WR2, WR4 and WR5 of TPL-(012 through 014)-WECC-RBP-2 coincident with the October 17, 2015 Effective Date of NERC TPL-001-4, Transmission System Planning Performance requirements. (See 18 CFR Part 40, Docket RM-12-1-000 and RM13-9-000, FERC Order 786, issued October 17, 2013.) Table W-1, WECC Disturbance-Performance Table of Allowable Effects on Other Systems, Table W-1 Notes, Figure W-1, and Footnotes 1-3 were also retired along with their supporting WECC Requirements, WR1, WR2, and WR5. On December 5, 2013, the Board ratified that decision.</td>
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<tr>
<td>2.1</td>
<td>June 25, 2014</td>
<td>Board changed designation</td>
<td>Changed from regional Business Practice (RBP) to Criterion (CRT). No other changes.</td>
</tr>
<tr>
<td>2.2</td>
<td>January 14, 2016</td>
<td>Errata</td>
<td>Retired WECC Requirements WR1, WR2, WR4, and WR5 and their subsets were removed from the document. WR3 was renumbered to WR1.</td>
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<tr>
<td>2.3</td>
<td>September 20, 2016</td>
<td>Errata</td>
<td>Sub-parts of the 4.2 Facilities section impacted by the retirement of WR1, WR2, WR4 and WR5 of TPL-(012 through 014)-WECC-RBP-2 were removed.</td>
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<td>3</td>
<td>September 21, 2016</td>
<td>Board approved</td>
<td>This document addresses: 1) the substance of its preceding versions, 2) requirements imposed by NERC TPL-001-4, Transmission System Planning Performance Requirements, Requirements R5 and R6, and 3) the substance of Table W-1 retired from Version 2.1. The Effective Date was approved as “the later of January 1, 2016 or the Effective Date of TPL-001-4, Transmission System Planning Performance, Requirements R2-R6 and R8, subject to approvals.” Because the effective date of the NERC requirements has already been triggered the document was effective immediately on approval by the Board.</td>
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<tr>
<td>December 6, 2016</td>
<td>3.1</td>
<td>Errata</td>
<td>The spelling error in Section 4.2.2.6 “quantizes” was corrected to read “quantities.” In WM2, the phrase “the criteria was applied” was replaced with “the criterion was applied.”</td>
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</table>
| June 18, 2019 | 3.2 | Errata | Converted to newest template. In Version 3.2: 1) bulleting in 4.2 Facilities was corrected, 2) at 4.2.2.7, “their” was replaced with “its”, 3) use of “X%” was changed to “X percent” throughout, 4) use of “are/is allowed” was changed to “can” throughout, 5) WR4, “as long as” was replaced with “if”, “in excess” was replaced with “more than”, 6) Version History syntax was corrected, 7) Rationale section, “with the exception of the 500 kilo-volt class” changed to “except the 500 kilo-volt class”, Rationale section (last page) “don’t” was changed to “do not”, 8) Rationale section at WR4, second bullet “Prepared” replaced with “prepared” and at the next to the last paragraph, “time frame” was replaced with “period”.

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Attachments

Not used.
Rationale

A Rationale section is optional. If Rationale Boxes were used during the development of this project, the content of those boxes appears below.

Rationale for Requirement WR1

This is a planning criterion.

WR1 addresses NERC TPL R5 and R6.

WR1 is designed to state the base planning criteria the system must meet—unless an individual entity or group of entities has different criteria. WECC Requirements WR2 and WR3 allow for entities to have different criteria.

Neither WR2 nor WR3 changes the WR1 default; rather, WR2 and WR3 allow for deviation from the WR1 default. WR2 allows for a more stringent approach without changing the WR1 default. A more stringent approach may be used in accordance with WR2 so long as all the affected parties agree. Similarly, WR3 allows deviation from the default with the additional protection that when used, other Transmission Planners and Planning Coordinators can use the same criteria on that part of the system for the same category of planning events (e.g., P1 and P2).

In the context of Requirement WR1, the word “nominal” carries its common definition and could be, for example, either the base voltage or the operating voltage as established in the entity’s Planning Assessment. This means that nominal may have a varying definition or use from one entity to the next.

If an entity does not specify what is nominal, the default use of the term nominal defaults to the kilovolt class that is specified in the WECC Base Case, except the 500 kilovolt class, in which case the default nominal would be specified as 525 kilovolt.

Requirement WR1.1.2 refers to the post automatic equipment adjustment effect prior to manual adjustment.

Rationale for Requirement WR1.2

For purposes of this document, a BES bus that is serving load is the bus with direct transformation from BES-level voltage to distribution-level voltage that serves load.

In developing WR1.2, the drafting team was aware that eight percent is not the only practical percentage for use. Historically, stakeholders reported successfully using percentages between five and ten whereas others reported being under a regulatory mandate to use eight percent. To accommodate both positions the team selected the eight percent.

By default, only automatic post-contingency actions occurring in the studied timeframe are considered when calculating voltage deviation. This would include, among other things, capacitor or reactor
switching. For purposes of WR1.2, automatic generally means a programmed response not manually initiated.

For P1 there is no high voltage deviation requirement. For P2-P7, there is no low or high voltage deviation requirement. It is implied that P2 through P7 events do not require a voltage deviation beyond meeting the requirements in WR1.1.2.

For purposes of this document, a BES bus that is serving load is the bus with direct transformation from BES-level voltage to distribution-level voltage that serves load.

The following illustrations apply to WR1.3 and WR1.4, and not WR1.2.

The following diagrams are offered for illustrative purposes. They are not designed to depict all possible voltage trajectories.
Initial Voltage

80% of initial Voltage

Fault cleared

Bus Voltage Magnitude

WECC Criterion - TPL-001-WECC-CRT-3
WR1.3 Example

DELAYED RECOVERY

Voltage recovery above 80% of initial Voltage within 20 seconds

0 Seconds

Time

20 Seconds
WECC Criterion - TPL-001-WECC-CRT-3
WR1.4 Example
NORMAL RECOVERY 1

Volt recovery above 80% of initial Voltage

Time duration of Voltage dip below 80% of initial Voltage (shall not remain below 80% for more than 2 seconds)

Time duration of Voltage dip below 70% of initial Voltage (shall not remain below 70% for more than 30 cycles)

Initial Voltage

80% of initial Voltage

70% of initial Voltage

Fault cleared

0 Seconds

Time

20 Seconds

Bus Voltage Magnitude
WECC Criterion - TPL-001-WECC-CRT-3
WR1.4 Example

NORMAL RECOVERY 2

Initial Voltage

Voltage recovery above 80% of initial Voltage

80% of initial Voltage

70% of initial Voltage

Time duration of Voltage dip below 80% of initial Voltage (shall not remain below 80% for more than 2 seconds)

Time duration of Voltage dip below 70% of initial Voltage (shall not remain below 70% for more than 30 cycles)

Fault cleared

Bus Voltage Magnitude

0 Seconds

Time

20 Seconds

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Rationale for Requirement WR4

Requirement WR4 is designed to establish screening criteria that when exceeded may require further investigation of instability. The Requirement is not intended to show the presence of Cascading or instability. An entity can use these criteria for instability if they choose without imposing it on others. The term Cascading in WR4 is the NERC defined term.

In WR4, Bullet 1, the 125 percent threshold is imported from the Peak RC System Operating Limits Methodology. The 125 percent threshold should only be used for facilities where the trip setting is not known. If the trip setting is known that known setting should be used. For example, if the known trip setting is 150 percent of the continuous rating, this should take precedence over the 125 percent of the highest rating.

The specific amounts of unrestrained load loss addressed in WR4, Bullet three, are not specified in this document. Because of the breadth of the possible permutations, the amount should be left to the sound engineering judgment of the planning entity.

Rationale for Requirement WR5

Requirement WR5 addresses “what” must be achieved and does not address “how” to do it.

For a review of “how” to achieve the goals, please refer to:

- The WECC Voltage Stability Assessment Methodology

The intent of Requirement WR5 is to ensure the voltage stability of transfer paths as well as the system as a whole during peak load or peak transfer conditions. A margin on real power flow is used as a test for voltage stability. A positive reactive power margin can be demonstrated by a valid steady state power flow solution.

Power flow solutions refer to post contingency conditions where the actions of reactive devices and load tap changers should be modeled for the appropriate period being studied.

There is a higher likelihood of occurrence of a P0 to P1 category event; therefore, a higher margin (105%) is used. For P2–P7, there is a lower likelihood of occurrence; therefore, the lower margin (102.5%) is used.
Rationale for Requirement WR6

Requirement WR6 ensures the free flow of information between entities.