



Document name	WECC Board of Directors Request Regarding Performance Category Upgrade Request
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White Paper:
WECC Board of Directors Request Regarding
Performance Category Upgrade Request

By

Reliability Subcommittee
Western Electricity Coordinating Council

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Problem Statement

During its July 27, 2012 meeting, the Western Electricity Coordinating Council (WECC) Board of Directors (Board) discussed the Transmission Re-categorization Process. WECC Board members raised questions about the event probabilities and their impact to reliability. The Board stated that it would like to see this process in the larger context of reliability in the West. As a result, the following assignment was made at the Board meeting:

That the WECC Board assigns the WECC Planning Coordination Committee the task of reviewing the criteria and its associated processes that involve parallel transmission lines in corridors, the A to D categorization and the associated exemption processes to make sure reliability of the Bulk Electric System is preserved, particularly looking at severe consequence of low-probability events. The Planning Coordination Committee (PCC) will report back to the Board with a recommendation to maintain the process as is or modify, with appropriate reasons, supporting such recommendations. At the next Board meeting, the PCC will notify the Board of the timeline to complete such a task.

Scope of work

In response to this assignment, the Reliability Subcommittee (RS), under the PCC, has developed this white paper. The paper reviews:

1. Applicable WECC and North American Electric Reliability Corporation (NERC) Criteria/Standards;
2. The current Performance Category Upgrade Request (PCUR) process; and
3. The WECC Board's concern about low-probability/high-impact events.

Standards and Criteria Governing PCUR

Background

WECC has adopted specific voltage and frequency dip criteria that go beyond the requirements of the NERC Standards. The WECC System Performance Criterion TPL-001-WECC-CRT-2 (renamed to TPL-001-WECC-RBP-2)¹ goes beyond the NERC Standards with respect to the performance expected from two adjacent circuits within a common right-of-way. However, the WECC criterion allows for two adjacent circuits within a common right-of-way to meet to the less stringent NERC requirement if the owner can demonstrate that the probability of the simultaneous outage of the two adjacent circuits is sufficiently low. This demonstration process is called the Performance Category Upgrade Request process (PCUR Process).

The WECC PCUR Process includes a peer review and acceptance process to demonstrate the low probability of a shared event involving the two adjacent circuits and to obtain industry consensus. The project sponsor initiates a review by submitting a PCUR to the Reliability Performance Evaluation Work Group (RPEWG) that, when approved, goes to the RS, then the PCC, and finally to the WECC Board of Directors for approval. In its PCUR report, the project sponsor provides information required by the Seven Step Process summarized below. Once a Category adjustment is accepted by industry, the project sponsor still has to demonstrate compliance with the NERC Reliability Standards. The RS believes that the acceptance process by the various committees above is an affirmation that the process has been followed and the steps of the process have been completed to the industry's satisfaction. This is a similar philosophy as that of the Path Rating Process in establishing an Accepted Rating. PCC affirms by consensus that the process has been followed and is complete. If an event actually occurs, the burden of proof should still be on the project owners/sponsors. This is evident in requirement R5 in the WECC System Performance Criterion.

NERC Standards and WECC Criterion

The present NERC Reliability Standard TPL-003-0a — System Performance Following Loss of Two or More BES Elements (NERC Category C performance), only applies to the simultaneous loss of two transmission circuits on a common tower. Simultaneous loss of two transmission circuits on separate towers is studied as two independent lines even when they are adjacent to each other (NERC Category D performance).

¹ TPL-001-WECC-CRT-2 has been renamed as TPL-001-WECC-RBP-2 and is now a WECC Regional Business Practice. However, the references in this document were created using the criterion and for consistency, they have been retained.

The WECC System Performance Criterion is more stringent than the NERC Standards and requires that two adjacent transmission circuits on separate towers be studied assuming a simultaneous common mode outage (WECC Category C performance). In WECC, the NERC Transmission Planning (TPL) standards that apply to two transmission circuits on the same tower are also applied to two adjacent transmission circuits even if they are on separate towers unless the probability of such an outage is demonstrated to be below a specified value and the project has completed the PCUR Process.

The WECC System Performance Criterion requires specific voltage and frequency disturbance performance (see Table W-1, Attachment 1) and allows WECC performance category adjustments depending upon actual or expected performance. This adjustment process is very rigorous and requires several levels of approval including WECC Board approval. As shown in Attachment 2, adjustments have only been approved moving required performance from Category C – meeting specified voltage and frequency performance; to Category D – evaluate for risks and consequences. Most of the projects that have been given WECC Category exemptions still must demonstrate there is no cascading to comply with WECC performance requirements.

The WECC RS and the WECC Standards Committee (WSC) have initiated Project WECC-0100 under the WSC, are currently in the process of re-evaluating the WECC System Performance Criterion, and will provide recommendations regarding changes to the WECC TPL criterion. One example of the required changes is the WECC System Performance Criterion will have to be revised to make it consistent with updates that are proposed in NERC Standard TPL-001-2, which is currently in the Standards Development Process.

In addition to the WECC criterion, NERC Standards FAC-010 and FAC-011, System Operating Limits Methodology, also contain Regional Differences that require the evaluation of the outage of two adjacent circuits on separate towers for establishing System Operating Limits (SOL). The relevant criteria and standards are listed below for reference.

WECC Criterion

TPL-001-WECC-CRT-2 – System Performance Criterion (renamed to TPL-001-WECC-RBP-2) contains the following requirements.

- R1.*** *In addition to NERC Table 1,² each Planning Coordinator and Transmission Planner shall comply with WECC's Disturbance-Performance Table (Table*

² NERC TPL-001-0 through TPL-004-0 Planning Standards.

W-1) of Allowable Effects on Other Systems and Part 1.1–1.4, contained in this section, when planning the Transmission System in the Western Interconnection.

1.4. *The NERC Category C.5³ initiating event of a single-line-to-ground fault with normal clearing shall also apply to the common mode contingency of two Adjacent Transmission Circuits on separate towers — unless the Mean Time Between Failure (MTBF)⁴ is determined to be greater than 30 years (i.e., outage frequency is less than 0.033 outages per year).*

1.5. *For contingencies involving existing or planned facilities, the Table W-1 performance category can be adjusted based on actual or expected performance (e.g., event outage frequency and consideration of impact) after receiving Board approval to change the Performance Level Adjustment Record.*

R5. *For any event that has actually resulted in cascading, action must be taken so that future occurrences of the event will not result in cascading; or it must demonstrate that the Mean Time Between Failure (MTBF) is greater than 300 years (frequency less than 0.0033 outages/year) and approved by PCC.*

5.1 *Any contingency adjusted to Category D must not result in a cascading outage unless the MTBF is greater than 300 years (frequency less than 0.0033 outages/year); or the initiating disturbances and corresponding impacts are confined to either a radial system or a local network.*

NERC Reliability Standards

FAC-010-2.1 and FAC-011-2.1 Regional Difference Requirement E.1.1.5 require the evaluation of the following multiple Facility Contingencies when establishing SOLs.

1.1.5 A non-three phase Fault with Normal Clearing on common mode Contingency of two adjacent circuits on separate towers unless the event frequency is determined to be less than one in thirty years.

³ NERC Table 1

⁴ WECC Seven Step Process for Performance Category Upgrade Request at:
[http://www.wecc.biz/committees/StandingCommittees/PCC/RS/RPEWG/Shared%20Documents/Seven Step Process BOD Approved 12-7-04.pdf](http://www.wecc.biz/committees/StandingCommittees/PCC/RS/RPEWG/Shared%20Documents/Seven%20Step%20Process%20BOD%20Approved%2012-7-04.pdf)

WECC Guidelines and Board-Approved Policies

- Probabilistic-Based Reliability Criteria (PCUR Phase 1)
- Robust Line Design
Benefits of Robust Line Design, Substation Configuration, Vegetation Management (approved in 2003)
- Seven Step Process for Performance Category Upgrade Request (approved in 2004)

Response to WECC Board's Concern:

The WECC Board's concern about the performance category readjustment and concern for low-probability/high-impact events is very well addressed by the Seven Step Process for Performance Category Upgrade Request. It is a rigorous process that makes sure that the applicant fully evaluates the impact of category change on the reliability of the system. Specifically, the process contains the following steps:

Step 1. Project (Facility) Description

A complete description of the project including supportive data such as substation configuration, physical layout, protective relaying, various potential hazards, climate, terrain, and mileage and common corridor description are required.

Step 2. Outage Database - The Sample

A minimum of 10 years of outage data is required.

Step 3. Mean Time Between Failure Calculation

A detailed description of MTBF calculations is given including what data to include and how to treat the data.

Step 4. Robust Line Design

Requires description of Robust Line Design features used in the line design. Guidelines for robust line design features are included in the document "Robust Line Design Features" dated December 5, 2003.

Step 5. Exposure Analysis

The exposure analysis describes the hours per year there would be exposure to not meeting the more stringent WECC performance criteria.

Step 6. Illustrate the Consequences of An Outage

This step requires that the study be conducted to evaluate the consequence of the outage such as transient voltage dip violations, overloads, megawatt customer loss, and cascading. It also requires an illustration of the entities

impacted by the outage and the severity of the impact. Finally, it also requires a discussion of any existing mitigation measures.

This is where the risk to the Bulk Electric System is quantified. This analysis plays a major role in the decision to grant an exception (Category change request). Thus, before the exception is approved, the RS, PCC, and WECC Board are fully aware of the impact of granting the exception.

Step 7. Report

This step requires a comprehensive written report be submitted to the RPEWG that fully describes the Steps 1 through 6 above, and provides an executive summary and overview.

Note: In this review, the RS has identified that once the process is completed there is no follow-up monitoring of performance.

High-Impact/Low-Probability Events History

During the 1994-2009 periods there were:

- 187 events where at least 1000 MW of generation were lost.
- 26 events where at least 2000 MW of generation were lost.
- 6 events where at least 3000 MW of generation were lost.
- 3 events where at least 4000 MW of generation were lost.

However, none of these events are linked to Performance Category adjustments granted. Therefore, based upon the available data, it can be concluded that the category change has not degraded system reliability. In the unlikely event a simultaneous outage of two adjacent transmission circuits on separate towers occurs, the outcome of the event would have been studied as required by Step 6, and the industry would know of the potential event's consequences. Any consequences from the event should still be in compliance with all NERC reliability requirements. In the event actual performance of the facilities does not achieve the event outage frequency or expected performance, the performance category may be adjusted back to the more stringent WECC performance category as described in part 1.4 of requirement R1 of the criterion.

Safety Nets to Address Low-Probability/High-Impact Events

The WECC Board asked about low-probability/high-impact events. The low-probability events that cause high impact are well beyond those anticipated in most requirements of the NERC TPL Standards where multi-circuit outages on separate structures are only required to be evaluated for risk and consequences (see existing NERC TPL-004-4 and

proposed NERC TPL-001-2 requirements R3 and R4). In the TPL-001-WECC-CRT-2 Criterion, low-probability/high-impact events are only addressed when studying adjacent transmission circuits that are greater than 300 kV and where the multi-circuit outage has actually occurred, resulting in cascading (see TPL-001-WECC-CRT-2 requirement R5). Then the Planning Coordinator or Transmission Planner must take action so that future occurrence of the event will not result in cascading, or the PCC must approve that the Planning Coordinator or Transmission Planner has demonstrated that the MTBF is greater than 300 years.

Conclusions and Recommendations:

The WECC Board's concern about the category readjustment and concern for low-probability/high-impact events related to the Performance Category Adjustment Process is fully addressed by the Seven Step Process. It is a rigorous process and makes sure that the applicant fully evaluates the impact of performance category changes on the reliability of the system. The report goes through evaluation by the RPEWG, RS, and PCC before it is submitted to the WECC Board for approval. At every step of the process, the impact of the category change to BES reliability is evaluated and a recommendation to the WECC Board is made only after all concerns have been satisfied.

The purpose of the PCUR process is to allow adjustment of performance categories under the WECC System Performance Criterion and in conformance with existing NERC Reliability Standards. The RS currently recommends that the present PCUR process be retained pending the outcome of Project-0100 of the WECC Standards Committee. Any review and modification of the PCUR process must be linked to the review and modification of the WECC Criterion, the outcome of current NERC Project 2010-17, and proposed refinements to the Regional Differences in FAC-010-2.1 and FAC-011-2.

Attachment 1

**WECC DISTURBANCE-PERFORMANCE TABLE
OF ALLOWABLE EFFECTS ON OTHER SYSTEMS**

NERC and WECC Categories	Outage Frequency Associated with the Performance Category (outage/year)	Transient Voltage Dip Standard	Minimum Transient Frequency Standard	Post Transient Voltage Deviation Standard (See Note 3)
A	Not Applicable	Nothing in addition to NERC.		
B	· 0.33	<p>Not to exceed 25% at load buses or 30% at non-load buses.</p> <p>Not to exceed 20% for more than 20 cycles at load buses.</p>	Not below 59.6 Hz for 6 cycles or more at a load bus.	Not to exceed 5% at any bus.
C	0.033 – 0.33	<p>Not to exceed 30% at any bus.</p> <p>Not to exceed 20% for more than 40 cycles at load buses.</p>	Not below 59.0 Hz for 6 cycles or more at a load bus.	Not to exceed 10% at any bus.
D	· 0.033	Nothing in addition to NERC.		

Table W-1

Notes:

1. The WECC Disturbance-Performance Table applies equally to either a system with all elements in service, or a system with one element removed and the system adjusted.
2. As an example in applying WECC's Disturbance-Performance Table, a Category B disturbance in one system shall not cause a transient voltage dip in another system that is greater than 20 percent for more than 20 cycles at load buses, or exceed 25 percent at load buses, or 30 percent at non-load buses at any time other than during the fault.

3. If it can be demonstrated that post-transient voltage deviations that are less than the values in the table will result in voltage instability, the system in which the disturbance originated and the affected system(s) shall cooperate in mutually resolving the problem.
4. Refer to Figure W-1 for voltage performance parameters.
5. Load buses include generating unit auxiliary loads.
6. To reach the frequency categories shown in WECC's Disturbance-Performance Table for Category C disturbances, some planned and controlled islanding may occur. Underfrequency load shedding is expected to arrest this frequency decline and assure continued operation within the resulting islands.
7. For simulation test cases, the interconnected transmission system steady-state loading conditions prior to a disturbance shall be appropriate to the case. Disturbances shall be simulated at locations on the system that result in maximum stress on other systems. Relay action, fault clearing time, and reclosing practice shall be represented in simulations according to the planning and operation of the actual or planned systems. When simulating post-transient conditions, actions are limited to automatic devices, and no manual action is to be assumed.

Attachment 2

Performance Level Adjustment Record (PLAR)						Comments
Facility Outage	Specified Category	Adjusted Category	>300 Yr MTBF	Cascading Allowed	Date BOD Approved	
Hassayampa-Pinal West and Hassayampa-Jojoba 500-kV lines	C	D	No	No	6/27/2012	
Hassayampa-Pinal West and Jojoba-Kyrene 500-kV line	C	D	No	No	6/27/2012	
Hassayampa-North Gila existing and 2nd Future 500-kV lines	C	D	No	No	12/8/2010	
Palo Verde-Westwing Line 2 and Palo Verde-Rudd 500-kV lines	C	D	Yes	No	12/8/2010	
Imperial Valley-Miguel and Imperial Valley-Central 500-kV lines	C	D	No	No	4/16/2008	
Both Palo Verde-Westwing 500-kV lines	C	D	Yes	No	Aug-03	
Raver-Echo Lake and Shultz-Echo Lake 500-kV lines	C	D	Yes	Yes	Aug-02	
From Prior Exceptions List						
Laramie River-Ault and Laramie River-Beaver Creek 345-kV lines	D	D	NA		Aug-01	Separate rights-of-way, Separate substation bays
Navajo-McCullough and Navajo-Moenkopi 500-kV lines	D	D	NA		Aug-01	Separate rights-of-way, Separate substation bays
Navajo-Westwing and Navajo-Moenkopi 500-kV lines	C	D	No		Aug-01	Same right-of-way, no 2 line outages have occurred
Palo Verde-Devers and Palo Verde North Gila 500-kV lines	D	D	NA		Aug-01	Separate rights-of-way, Separate substation bays
Lugo-Eldorado and Lugo-Mohave 500-kV lines	C	D	No		Aug-01	Same right-of-way for only 33% of length
Navajo-McCullough and Moenkopi-Eldorado 500-kV lines	D	D	NA		Aug-01	Separate rights-of-way, Separate substations

(other exceptions were RAS failures - omitted because handled differently)

NA - No Probabilistic-based Reliability Criteria adjustment is needed because the facilities are on different rights-of-way with different terminations

Updated June 29, 2012