Reliability Performance Evaluation Work Group

Phase I Probabilistic Based Reliability Criteria

Implementation Procedure

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RPEWG members

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1.0 INTRODUCTION

The introduction of probabilistic planning is intended to optimize performance without degrading system reliability. The performance requirements of the *NERC/WECC Planning Standards are* established based on deterministic methods. For the rare case where a facility should meet a standard other than the classification dictated by the NERC/WECC Planning Standards, this probabilistic based reliability criteria (PBRC) will provide a means to reclassify the facility. If a facility has excessive outages for its classification, then it should be expected to meet the requirements of a more stringent performance category. If a facility can be shown to perform much better as compared to its normal classification, the facility operator may request that the facility be qualified to meet the requirements of a less stringent performance category.

Any changes or additions to deterministic standards are set by other groups and are not part of this process. This process addresses only the requirements relative to changing a facility's performance requirement to a category other than its normal deterministic demarcation.

1.1 Background and Purpose

a) In 1998 the Probabilistic Methods Work Group (PMWG) of the Reliability Subcommittee (RS) recommended a phased-in development and implementation of a PBRC for WECC.

b) In 1999 PCC formed the ***Reliability Performance Evaluation Work Group (RPEWG)*** to conduct reliability evaluation of Exceptions List Facilities as a test of the Phase I PBRC (Event Probability) application.

c) The purpose of this document is to provide a detailed implementation procedure on Phase I PBRC.

d) All considerations to past or future criteria exception issues are handled through the application of the Phase I PBRC under this procedure.

1.2 Phase 1 PBRC Performance Table

a) The Phase I PBRC that was approved in 1998 for incorporation into the WECC Reliability Criteria Performance Table is shown in Table A.

b) Under the ongoing work of merging the WECC Reliability Criteria for Transmission System Planning with the NERC's Planning Standards, a two-stage approach is providing in the implementation of the Phase I PBRC.

- Stage 1: Implementation of Phase I PBRC into the NERC/WECC Planning Standards Table W-1 (WECC table) for limited application to external systems while still meeting the minimum requirements of the NERC/WECC Planning Standards Table 1 (NERC table). Under Stage 1, Table B will be implemented. (Table B is the same as Table W-1 of the NERC/WECC Planning Standards.) Furthermore, the following requirement is added to the application Table B:

  Category D must not result in cascading unless the estimated MTBF can be shown to be greater than 300 years (or 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.

- Stage 2: Implementation of Phase I PBRC to fully apply to the requirements of the NERC/WECC Planning Standards Table 1 (NERC table) thus applying to internal and external systems as well as allowing probabilistic based adjustments to the minimum requirements of the performance categories.

Table A: Phase I PBRC Performance Table

Performance Level	Disturbance Outage Class	Outage Frequency (outages/year)	Mean-Time-Between-Failure (year)	ΔV_1 (%)	Δt (cycle)	ΔV_2 (%)	f_{min} (Hz)	Damp. (%)
A	Single Element	0.33 ≤	≤ 3	25	20	5	59.6	>0
B	Bus Section	0.033 - 0.33	3 - 30	30	20	5	59.4	>0
C	Two Element	0.033 - 0.33	3 - 30	30	40	10	59.0	>0
D	More than Two Elements (I)*	0.0033 - 0.033	30 - 300	NO CASCADING PERMITTED				
E	More than Two Elements (II)*	< 0.0033	300 <	EVALUATE FOR RISKS & CONSEQUENCES				

Notes * These two classifications, I & II, describe the new contingency definitions for level D and E Performance Levels approved at the February 12-13, 1998 PCC meeting. The classifications are related to splitting the existing WECC Level D (as well as the Categories D of the new NERC Planning Standards) into two classes.

ΔV_1, Δt, ΔV_2, f_{min} and Damping are defined in the June 25, 1998 Phase I PBRC Development and Implementation report.

Table B: Phase I PBRC Performance Table for the NERC/WECC Planning Standards

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 2)
A	Not Applicable	Nothing in addition to NERC		
B	≥ 0.33	Not to exceed **25%** at load buses or **30%** at non-load buses. Not to exceed **20% for more than 20 cycles** at load buses.	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	Not to exceed **30%** at any bus. Not to exceed **20% for more than 40 cycles** at load buses.	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		

2.0 IMPLEMENTATION PROCEDURE

2.1 Philosophy

a) Phase I PBRC Event Probability figures are used to establish outage frequency ranges for each ***Disturbance Outage Class (DOC)***[1] in the NERC/WECC Planning Standards Disturbance-Performance Table of Allowable Effects on Other Systems. (This is the consideration for the Stage 1 implementation as described in Section 1.2b.)

b) The application of Phase I PBRC (Event Probability) does not comply with all aspects of the NERC/WECC Planning Standards. It may require special recognition or approval by NERC to fully implement PBRC for WECC. (This is the consideration for the Stage 2 implementation as described in Section 1.2b.)

c) Phase I PBRC DOC frequency ranges will be applied to evaluate performance category assignments for the following conditions:
- *Exceptions List*[2] facilities
- Existing facilities with poor performance
- Existing facilities with exceptionally good performance
- Planned facilities projected to have exceptionally good performance

d) ***Performance Category Evaluation (PCE)*** includes event probability assessment of a facility taking into consideration the facility's physical characteristics, design considerations, operational history, geographic location, environmental surrounding, reliability calculations or other appropriate factors.

e) An existing facility found to have higher outage frequency than its DOC may be downgraded in its performance category following PCE.

f) An existing facility found to have lower performance outage frequency than its DOC may be *upgraded*[3] in its performance category upon request by the facility operator and following PCE.

g) A planned facility expected to have lower outage frequency than its DOC may be upgraded in its performance category upon request by the facility operator and following PCE.

h) Upgraded single element outage facilities are not allowed to have performance worse than that specified for Category C.

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[1] Disturbance Outage Class (DOC) = Element outage groups specified in the second column of the NERC/WECC Planning Standards Table 1. Four Disturbance Outage Classes are defined corresponding to the performance Categories A, B, C, and D. For instance, Disturbance Outage Class B corresponds to outages or contingencies associated with one generator, one circuit, one transformer or DC monople.

[2] Exceptions List = A list generated by WECC Technical Studies Subcommittee which contains facilities that have been granted exceptions by WECC from meeting the WECC Reliability Criteria for Transmission System Planning. (The list is given in Appendix E of the June 25, 1998, Phase I PBRC report.)

[3] Upgrade = Making the performance level (category) requirement less stringent; for example changing requirement from Category A to B, or C to D.

i) When considering performance category upgrade or downgrade of a facility, the facility's outage impact and risk exposure should be part of the consideration.

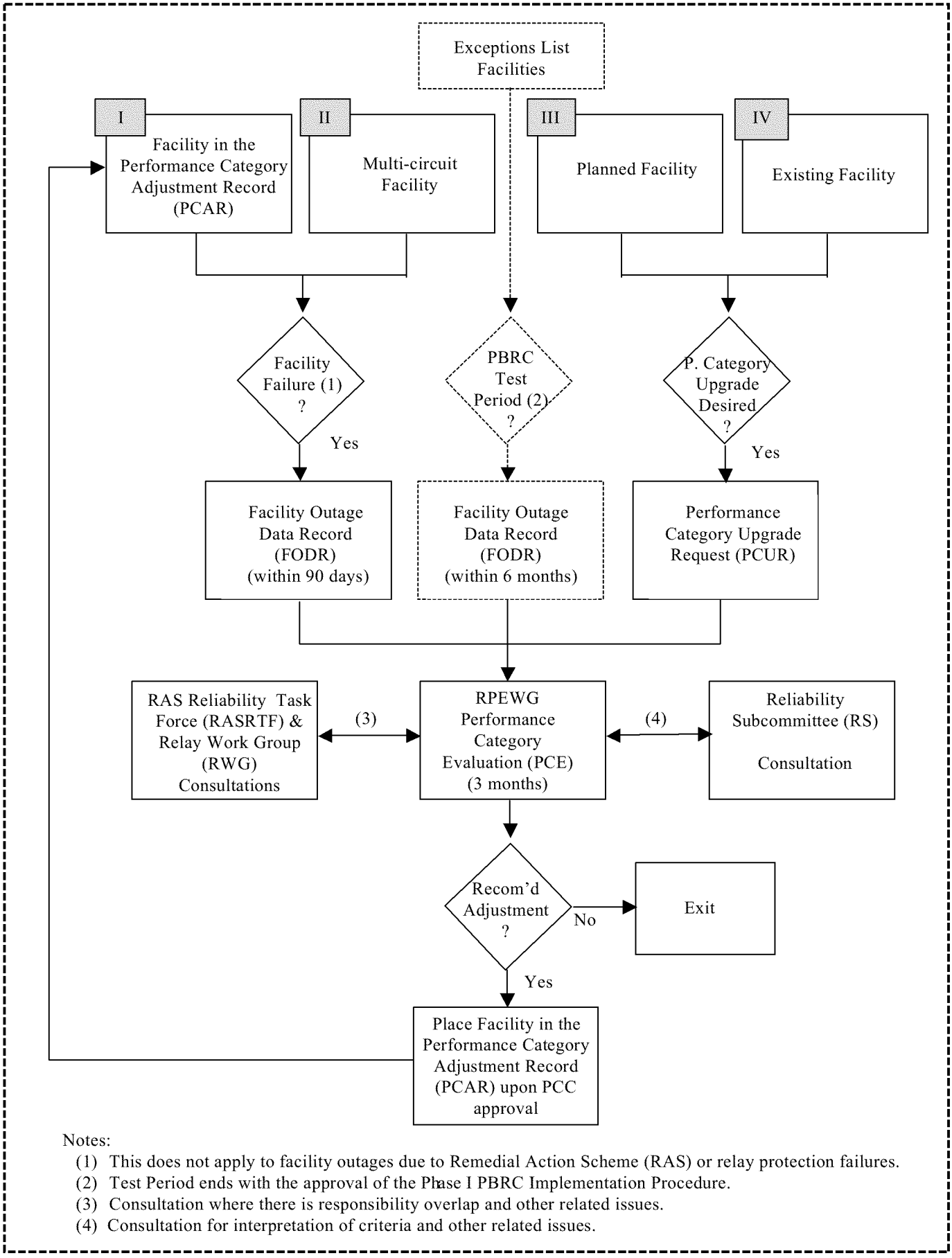
j) The Exceptions List will be eliminated and separate lists will be established for facilities that have been upgraded after going through PCE. No facility upgrades will be termed an exception to the criteria but rather an adjustment of performance requirements within the criteria. Exceptions list facilities that have been upgraded in the initial Stage 1 based evaluation will need further evaluation under Stage 2 implementation to determine whether they meet the 300 year MTBF level or not.

k) All facility upgrade requests must include a reliability analysis showing expected MTBF for the facility.

l) It is recognized that the development of Phases II and III (Impact Probability and Performance Risk measurements, respectively, as defined in the May 25, 1998 Phase I PBRC Development and Implementation Report) are needed to more accurately formulate PBRC, and that Phase I PBRC will be used until Phase II development is completed.

2.2 Implementation Process

a) The overall Phase I PBRC performance evaluation and rating adjustments process is shown Figure 1.



Notes:

(1) This does not apply to facility outages due to Remedial Action Scheme (RAS) or relay protection failures.
(2) Test Period ends with the approval of the Phase I PBRC Implementation Procedure.
(3) Consultation where there is responsibility overlap and other related issues.
(4) Consultation for interpretation of criteria and other related issues.

Figure 1: Phase I Probabilistic Based Reliability Criteria Implementation Process

3.0 APPLICATION GUIDELINE

3.1 General

a) The WECC Reliability Subcommittee (RS) should revise the NERC/WECC Planning Standards to incorporate the event probability Phase I PBRC. (For the Stage 1 implementation, new WECC Standard is needed to address the application of PBRC. With Stage 1 implementation, several existing WECC standards that are more stringent than the NERC will be eliminated.)

b) WECC should make an official request to NERC to make special recognition of the Phase I PBRC application for the WECC so that Stage 2 can be implemented. (WECC RS should start a process to address the PBRC application at the NERC level.)

c) Owners or operating agents of *bulk power facilities*[4] should maintain historical outage records of these elements regardless of the effects of the outages.

d) The facility outage records should be detailed enough to allow the facility owner or operating agent to compile the ***Facility Outage Data Report (FODR)***. The requirements of this report may include the items given below.

   i. Facility Description: Facility characteristic information such transformer kV, MVA ratings; transmission line kV, length, routing, terrain, voltage rating, size; etc.

   ii. Pre-Outage Condition: Equipment loading, configuration, status, etc., prior the occurrence of the outage.

   iii. Outage Frequency: Forced momentary, and forced permanent for 200 kV and above power system elements.

   iv. Outage Duration: Forced momentary, and forced permanent outage or the element as well as the outage class.

   v. Multi element outage: Simultaneous outages of two or more elements, dependent outages, etc.

   vi. Outage impact: Min/Max frequency excursions, voltage swing dips, post-disturbance voltage deviations, equipment overloads, load dropping, cascading system outages, etc.

   vii. Historical Record: The data should cover not less than ten (10) years of historical record.

   viii. Reliability evaluation: A MTBF and other reliability evaluation considering the historical outage and design data of the facility and of other comparable facilities, as well as utilizing other appropriate statistical methods.

[4] Bulk Power Facility: For the purpose of WECC Reliability Criteria Application, Bulk Power Facility is defined as transformers (500 MVA or larger), transmission lines (230 kV class or higher), and associated equipment such as Remedial Action Schemes, breakers, relays, communication, controls, etc.

3.2 Multi-circuit Facilities and Facilities that have been Granted Upgrade

a) FODR of a bulk power facility should be provided to the WECC RPEWG within 90 days after an occurrence of: (i) an outage that involves a facility that has been granted a performance category upgrade, or (ii) a multi-element outage event of any facility. (Blocks I and II of Figure 1 Implementation Process.)

b) Facility outages that involve Remedial Action Scheme or relay protection scheme failures are not included in this evaluation. Other WECC groups are responsible for addressing such failures.

3.3 Existing Facility Performance Category Upgrade Request

a) *Performance Category Upgrade Request (PCUR)* could be submitted by owners of existing facilities that believe their facilities should be granted performance category upgrade based on outage history, equipment characteristics, design and other considerations. (Block IV of Figure 1 Implementation Process.)

b) The request should include the FODR, the justifications for the performance category upgrade, a MTBF estimate and other issues for consideration in the assessment.

c) The request could be submitted to the WECC RPEWG at any time and would become effective once recommended by RPEWG and accepted by PCC.

3.4 Planned Facility Performance Category Upgrade Request

a) ***Performance Category Upgrade Request (PCUR)*** could be submitted by owners of planned facilities that believe their facilities should be granted performance category upgrade based on equipment characteristics, design and other considerations. (Block III of Figure 1 Implementation Process.)

b) The request should include an estimate of MTBF based on comparable facilities and a description of design considerations to be applied which provide a reasonable expectation that the new facility will meet or exceed the predicted performance and other issues for consideration in the assessment.

c) The request could be submitted to the WECC RPEWG at any time and would become effective once recommended by RPEWG and accepted by PCC.

3.5 WECC Reliability Performance Evaluation Work Group

a) The WECC Reliability Performance Evaluation Work Group (RPEWG) responsibility should include, but not be limited to, the following:

   i. Receive Performance Category Upgrade Request for existing facility, and Performance Category Upgrade Request for new facility and make determination whether to recommend granting performance category adjustment or not on the facilities.

   ii. Receive FODR of a bulk power facility that experiences an outage and make determination whether to recommend granting performance category downgrade or not on the facility when the outaged facility is one that has been granted performance category upgrade or is involved in multi-element outage.

c) RPEWG may reasonably request additional information or data associated with its performance category evaluation and determination and the entity(s) involved should furnish the data to the extent it is available.

d) In making performance adjustment determinations, RPEWG may not recommend performance category upgrades: (i) if the disturbance/outage impact of the facility is expected to be substantially higher than other typical facilities in the same DOC; or (ii) when the upgrade does not result in any significant loading or operational changes on the facility or the interconnected system.

e) RPEWG is expected to finish each evaluation within 3 months from the date of submittal.

f) Upon evaluation by RPEWG members, performance category adjustment recommendations are made to PCC for consideration and further actions.

g) RPEWG will maintain a record—***Performance Category Adjustment Record (PCAR***)--of facilities that have gone through the group's reliability evaluation process and have been granted performance category adjustments.

3.6 RPEWG Evaluation Guideline

a) In evaluation of outage data, generally, one outage occurrence of a facility is considered statistically insignificant regardless of the outage data time period since two or more outages are necessary to fail a MTBF test.

b) In cases where significant level of outage data of similar characteristic facilities is available, average-value outage data may be used in the reliability performance evaluation of Category C and D facilities. Outage data time period should cover not less than ten years. If data greater than 10 year is available, it can be used in the evaluation at the facility owner's discretion. For facilities that have been in operation less than ten years, data for the operational period will be used. In addition the RPEWG will review the required MTBF estimate provided by the facility owner as a basis for determining the maximum allowed category adjustment.

c) For categories C and D, forced automatic[5] common-mode[6] outages are counted. This will include:

   i. Right-of-way or corridor outages.

   ii. Failures of unknown nature.

d) For categories A and B, all forced automatic outages are counted.

e) Outages not counted include:

   i. System wide outages that are initiated outside the facility in question.

   ii. Scheduled outages.

   iii. Major natural disasters, earthquakes, or sabotage.

[5] An outage which results from automatic operation of switching devices.
[6] A related multiple outage event consisting of two or more primary outage occurrences initiated by a single incident where the outage occurrences are not consequences of eachother.

iv. Non-overlapping outages

f) RPEWG will consult Reliability Subcommittee (RS) for interpretation of criteria and other related issues. Likewise, RPEWG will consult the Remedial Action Scheme Reliability Task Force (RASRTF) or the Relay Work Group for cases where there are overlaps in the responsibility with those groups.

g) As a general guide, RPEWG recommends that a single outage occurrence that results in cascading system impact must be reviewed to determine if it should be declassified as a category upgrade facility.

h) RPEWG will make recommendations to the PCC regarding facility upgrade requests that are submitted three months before the next scheduled PCC meeting. This timeline may be reduced to six weeks if a statement is provided indicating why expedited evaluation is needed. It is the intent of this process that WECC actions on member system requests will not delay facility implementation schedules.

4.0 APPLICATION EXAMPLES AND SCENARIOS

a) Exceptions List Facility - performance category downgrading scenario

Facility: Lugo-Eldorado and Lugo-Mojave lines sharing the same corridor

Disturbance Outage Class: Two elements

Criteria Category Specified: C

Class Outage Frequency: 0.033-0.33 outages/year

Criteria Category Granted: D or higher

Historical Performance: one event in ten years (Hypothetical)

MTBF Estimate: 20 years based on comparable facilities

Recommended Category Adjustment: C (Downgrade)

Note: Although on e event is not considered to be statistically significant the MTBF estimate based on comparable facilities indicates the case should be rated at Category C.

b) Exceptions List Facility - Exceptions confirmation scenario

Facility: Lugo-Eldorado and Lugo-Mojave lines sharing the same corridor

Facility Outage Class: Two elements

Criteria Performance Level Specified: C

Class Outage Frequency: 0.033-0.33 outages/year

Criteria Performance Level Granted: (Exceptions List)

Historical Performance: 0.020 outages/year (Hypothetical)

Estimated MTBF: 350 years (Hypothetical)

Recommended Performance Level Adjustment: D (Exceptions List Level Confirmed)

Note: This assumes that the facility was provided exception based on the outage credibility of the corridor. Otherwise, if the exception was based on the credibility of having high impact level, the Phase I PBRC does not apply.

c) Existing Facility with Poor Performance - performance category downgrading scenario

Facility: Malin-Round Mountain lines 1 and 2 sharing the same corridor

Disturbance Outage Class: Two elements

Criteria Category Specified: C

Class Outage Frequency: 0.033-0.33 outages/year

Historical Performance: 0.50 outages/year (Hypothetical)

Recommended Category Adjustment: A (Downgrade)

d) Existing Facility with Exceptionally good Performance - performance category upgraded scenario

Facility: McCullough-Eldorado line (1-mile line)

Disturbance Outage Class: One element

Criteria Category Specified: A

Class Outage Frequency: ≥ 0.33 outages/year

Historical Performance: 0.020 outages/year (Hypothetical)

Recommended Category Adjustment: C (Upgrade)

Note: The line is so short that the outage frequency is substantially lower than the DOC. This may be based on historical as well as reliability assessment figures. Though the expected outage is very low and falls within the class for Category D performance, upgrade from A to D is not allowed. Thus, a Category C performance will be granted. However, in granting Category C performance ,it is understood that loss of load or generator will not be allowed because it is a single contingency event.

e) New Facility - Upgraded

Facility: Single Line X (5-mile line)

Disturbance Outage Class: One element

Criteria Category Specified: A

Class Outage Frequency: ≥ 0.033 outages/year

Expected Performance: 0.020 outages/year (Hypothetical)

Recommended Category Adjustment: C (Upgrade)

Note: The line is so short that the outage frequency is expected to be substantially lower than the DOC. Furthermore, special measure such as longer insulation strings may be used in the design of the line. Though the expected outage is very low and falls within the DOC for Category D performance, upgrade from A to D is not allowed. Thus, Category C performance is granted. However, in granting Category C performance it is understood that loss of load or generator will not be allowed because it is a single contingency event.

f) New Facility - Upgraded

Facility: Two lines on the same ROW (5-mile line)

Facility Outage Class: Two elements

Criteria Categroy Specified: C

Class Outage Frequency: $\leq$ 0.033 outages/year

Expected Performance: 0.002 outages/year (Hypothetical)

Recommended Category Adjustment: D (Upgrade)

5.0 MONITORING AND EVALUATION

a) WECC RS (through PMWG) and RPEWG will monitor activities of category upgrade request submittals and evaluate the need to modify any of the guidelines or event probability values.

b) PMWG will conduct WECC outage data surveys every three years to upgrade event probability values, if needed.

c) PMWG will evaluate the Phase I/Phase II integration impact and make any adjustment needed in Phase I.

d) The PMWG or RPEWG can recommend changes to any part of the PBRC and the associated guideline to the Reliability Subcommittee for consideration at any time.

Approved by the PCC on June 29, 2001

Approved by the BOT on August 7, 2001

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