
COLORADO COORDINATED PLANNING GROUP (CCPG) NERC/WECC COMPLIANCE REPORT AND REACTIVE MARGIN ANALYSIS October 6, 2008

1. INTRODUCTION

The purpose of this study is to help CCPG Transmission Planners meet selected Standards and Criteria set forth by the North American Electric Reliability Corporation (NERC) and the Western Electricity Coordinating Council (WECC) via a coordinated planning process. The transmission system performance assessment studies documented in this report specifically address NERC Standards TPL-001, TPL-002, TPL-003, and TPL-004. It is the responsibility of each Transmission Planner or Planning Authority to ensure that they are in compliance with NERC Standards. This report may not completely fulfill compliance requirements, and parties may have to supplement this information with other system analyses.

The studies consist of load flow, transient stability, and voltage stability analyses. The study area consists of the CCPG footprint, including the states of Wyoming and Colorado, and can be electrically described as the area bounded by Yellowtail to the north, the DC ties at Rapid City, Stegall, Sidney and Lamar to the east, TOT1A and Jim Bridger to the west, and TOT2A to the south. This study is generally completed annually, or as system conditions warrant.

The study was performed using PTI PSS/E version 30.3.0.

2. SYSTEM MODELS

The transmission system models were developed from models prepared by the Western Electricity Coordinating Council (WECC) to conduct assessments for the near-term (years one through five) and the longer-term (years six through ten) planning horizons. The two base cases included in this study originated from the 2013 heavy summer loading case (13HS1) and the 2018 heavy summer loading case (18HS1A). Previous planning studies have concluded that the heavy summer loading scenarios cover the most critical system topology and system conditions over the range of forecast system demand levels in the CCPG footprint. The cases include both existing and planned facilities. CCPG study participants reviewed these cases to ensure accurate load, generation, and topology modeling. These cases were also utilized in the CCPG Colorado Long Range Transmission Plan Study.

In the steady state analysis all Bulk Electric System (BES) high voltage ($\geq 115\text{kV}$) bus voltages and non-radial branch flows in the CCPG area are monitored for criteria violations.

The transient stability cases include the detailed Sidney DC tie, Stegall DC tie, and Rapid City DC tie models. All BES buses in the study area are monitored for voltage and major generating units in the area are monitored for stability.

3. CRITERIA

System performance was measured against criteria set forth by NERC, WECC, and CCPG. Regional voltage criteria are documented in the CCPG Rocky Mountain Voltage Coordination Guidelines (VCG).

a) Steady State - System Intact

Based on the VCG, voltages are maintained between 1.05 p.u. and 0.95 p.u. Transmission line and transformer loadings were flagged if they exceeded 100% of continuous rating. Shunt reactive device switching and transformer tap adjustments are enabled. Phase shifters are locked.

b) Steady State - Contingency

Category B – Based on the VCG, voltages are generally maintained between 1.10 p.u. and 0.90 p.u. Platte River Power Authority minimum bus voltage is 0.92 p.u. at load busses. Transmission line and transformer loadings were flagged if they exceeded 100% of continuous rating or an established

emergency rating. Automatic shunt reactive device switching is enabled. Transformer tap adjustments are locked. Phase shifters are locked.

Category C – Allowable emergency limits will be considered as determined by the affected parties and the available emergency mitigation plan. Curtailment of firm transfers, generation redispatch, and load shedding will be considered if necessary.

Category D – Evaluate for risks and consequences. If applicable, use allowable emergency limits as determined by available emergency mitigation plan. Curtailment of firm transfers, generation redispatch, and load shedding will be considered if necessary.

c) **Transient Stability**

NERC Standards require that the system remain stable for Category A, B, and C disturbances.

The *WECC Disturbance – Performance Table of Allowable Effects on Other Systems*, included in Appendix A, has the following requirements:

Category B: Any transient voltage dip must not exceed 25% at load buses or 30% at nonload buses. The dip also must not exceed 20% for more than 20 cycles at load buses. Frequency must not drop below 59.6 Hz for 6 or more cycles at a load bus.

Category C: Any transient voltage dip must not exceed 30% at load buses or 30% at nonload buses. The dip also must not exceed 20% for more than 40 cycles at load buses. Frequency must not drop below 59.0 Hz for 6 or more cycles at a load bus.

d) **Voltage Stability**

The established WECC voltage stability criteria for acceptable real power (MW) margins are as follows: 5% for Category A and B outages, 2.5% for Category C, and 0% for Category D outages.

4. PLANNING STANDARDS AND MEASUREMENTS

The following procedures were used for both the near term 2013 heavy summer loading base case and the long term 2018 heavy summer loading base case. The NERC/WECC Table 1, which contains the Category A, B, C, and D outage definitions, is provided in Appendix A.

All normal operating procedures and the effects of all control devices and protection systems are modeled. The effects of any BES equipment planned to be out-of-service during the critical demand levels are modeled. All projected firm transfers are modeled per the WECC base case detail. Reactive power resources are included in the model to ensure adequate reactive resources are available to meet system performance.

Category C and Category D contingencies are those that would produce more severe system results or impacts based on Transmission Planners knowledge of the system and engineering judgment. The rationale for selected disturbances considers the following: large bulk transfer paths, significant substations, large generation stations, transmission using common right-of-way (ROW), common structure, and breaker configuration/line location in selected substations.

The Category D contingencies selected on Western's system include all buses identified per their Critical Asset Methodology document which states that Western will test for cascading on all busses that have a maximum fault duty greater than 5000 MVA within the WACM BA, which account for 12 of the 22 Category D contingencies. Criteria violations are evaluated based on resulting consequences and are assessed whether any additional projects should be added to Western-RMR's Capital Investment Plan.

Planned upgrades, additions, or corrective actions needed to meet the performance requirements for each Category of contingency (outage) conditions are identified in the Appendices along with the system performance results.

TPL-001 N-0 System Performance (NERC Category A Outages)

Steady State: The case is checked for system intact criteria violations.

Transient Stability: A non-disturbance case is run.

TPL-002 N-1 System Performance (NERC Category B Outages)

Steady State: The NERC Category B outage list consists of all single branches in the CCPG study area operated at 115 kV or greater, plus the following major generating units in the CCPG area; Cherokee4, Comanche3, Pawnee, Rawhide, MBPP1, Nixon, Craig1, DJ4, and Wyodak.

Transient Stability: A list of Category B faults was created by the CCPG study participants to meet the requirements of the WECC/NERC standard. This Category B fault list for the 2013 and 2018 cases is provided in Appendix B.

TPL-003 N-2 System Performance (NERC Category C Outages)

Steady State: A list of Category C outages was created by the CCPG study participants to meet the requirements of the WECC/NERC standard. This Category C outage list for the 2013 and 2018 cases is provided in Appendix C.

Transient Stability: A list of Category C faults was created by the CCPG study participants to meet the requirements of the WECC/NERC standard. This Category C fault list for the 2013 and 2018 cases is provided in Appendix B.

TPL-004 Extreme Contingency (NERC Category D Outages)

Steady State: A list of Category D outages was created by the CCPG study participants to meet the requirements of the WECC/NERC standard. This Category D outage list for the 2013 and 2018 cases is provided in Appendix C.

Transient Stability: A list of Category D faults was created by the CCPG study participants to meet the requirements of the WECC/NERC standard. This Category D fault list for the 2013 and 2018 cases is provided in Appendix B.

5. VOLTAGE STABILITY

The voltage stability study consists of a PV analysis of the system contained within the TOT3/TOT5 area. The TOT3/TOT5 area is considered to be south of TOT3, north of the Colorado/New Mexico border, east of TOT5, and west of the east/west interconnect boundary. Load within the TOT3/TOT5 area is scaled up, area generation is held constant, and power is imported into the area in order to determine the collapse point. The voltage stability margin is calculated by comparing the TOT3/TOT5 area load in the initial base case to the scaled area load determined at the collapse point. The NERC Category A, B, C and D forced outages, as described in Section 4, are analyzed. The prior outages of major TOT3/TOT5 area generation facilities are also considered. Separate results for the prior outages of Comanche #3, Cherokee #4, and Pawnee #1 generation units are provided. For each generator prior outage other TOT3/TOT5 area generation is redispatched to make up for the lost generation. The established WECC voltage stability criteria for acceptable real power (MW) margins are as follows: 5% for Category A and B outages, 2.5% for Category C, and 0% for Category D outages. Both the 2013 and 2018 heavy summer cases are studied.

6. RESULTS

NEAR TERM BASE CASE – 2013 HEAVY SUMMER

AREA PATH FLOW; TOT3 = 1198, TOT7 = 167, TOT5 = 845, TOT4A = 148

TPL-001 N-0 System Performance (NERC Category A Outages)

Steady State: The results of the N-0 Steady State Analysis indicate NO criteria violations. The results of the N-0 Steady State Analysis are listed in Appendix D.

Transient Stability: The results of the N-0 Transient Stability Analysis indicate NO criteria violations. The results of the N-0 Transient Stability Analysis are listed in Appendix E.

TPL-002 N-1 System Performance (NERC Category B Outages)

Steady State: The results of the N-1 Steady State Analysis indicate numerous voltage and loading violations that appear to exceed the criteria stated in Section 3 of this report. The detailed results of the N-1 analysis are shown in Appendix D. In some instances, the simplified analysis showed violations that wouldn't occur under actual system operation. For other violations there are plans to achieve the required system performance. These plans include planned system upgrades or established operating procedures. The violations and comments for the N-1 Steady State Analysis are listed in Appendix D.

Transient Stability: The results of the N-1 Transient Stability Analysis indicate NO criteria violations. The results of the N-1 Transient Stability Analysis are listed in Appendix E.

TPL-003 N-2 System Performance (NERC Category C Outages)

Steady State: The results of the N-2 Steady State Analysis indicate numerous voltage and loading violations that appear to exceed the criteria stated in Section 3 of this report. The detailed results of the N-1 analysis are shown in Appendix D. In some instances, the simplified analysis showed violations that wouldn't occur under actual system operation. For other violations there are plans to achieve the required system performance. These plans include planned system upgrades or established operating procedures. The violations and comments for the N-2 Steady State Analysis are listed in Appendix D.

Transient Stability: The results of the N-2 Transient Stability Analysis indicate NO criteria violations. The results of the N-2 Transient Stability Analysis are listed in Appendix E.

TPL-004 Extreme Contingency (NERC Category D Outages)

Steady State: The results of the “Extreme Contingency” Steady State Analysis indicate several loading and voltage violations which exceeded the criteria stated in Section 3 of this report. The violations and comments for the “Extreme Contingency” Steady State Analysis are listed in Appendix D.

Transient Stability: The results of the “Extreme Contingency” Transient Stability Analysis indicate NO transient voltage violations. The results of the N-2 Transient Stability Analysis are listed in Appendix E.

LONG TERM BASE CASE – 2018 HEAVY SUMMER

AREA PATH FLOW; TOT3 = 1199, TOT7 = 66, TOT5 = 524, TOT4A = 432

TPL-001 N-0 System Performance (NERC Category A Outages)

Steady State: The results of the N-0 Steady State Analysis indicated voltage and overload violations. The results of the N-0 Steady State Analysis are listed in Appendix F.

Transient Stability: The results of the N-0 Transient Stability Analysis indicate NO criteria violations. The results of the N-0 Transient Stability Analysis are listed in Appendix G.

TPL-002 N-1 System Performance (NERC Category B Outages)

Steady State: The results of the N-1 Steady State Analysis indicate numerous voltage and loading violations that appear to exceed the criteria stated in Section 3 of this report. The detailed results of the N-1 analysis are shown in Appendix F. In some instances, the simplified analysis showed violations that wouldn’t occur under actual system operation. For other violations there are plans to achieve required system performance. These plans include planned system upgrades or established operating procedures. The violations and comments for the N-1 Steady State Analysis are listed in Appendix F.

Transient Stability: The results of the N-1 Transient Stability Analysis indicate NO criteria violations. The results of the N-1 Transient Stability Analysis are listed in Appendix G.

TPL-003 N-2 System Performance (NERC Category C Outages)

Steady State: The results of the N-2 Steady State Analysis indicate numerous voltage and loading violations that appear to exceed the criteria stated in Section 3 of this report. The violations and comments for the N-2 Steady State Analysis are listed in Appendix F.

Transient Stability: The results of the N-2 Transient Stability Analysis indicate NO transient voltage violations. The results of the N-2 Transient Stability Analysis are listed in Appendix G.

TPL-004 Extreme Contingency (NERC Category D Outages)

Steady State: The results of the “Extreme Contingency” Steady State Analysis indicate several loading and voltage violations that exceeded the criteria stated in Section 3 of this report. The violations and comments for the “Extreme Contingency” Steady State Analysis are listed in Appendix F.

Transient Stability: The results of the “Extreme Contingency” Transient Stability Analysis indicate NO transient voltage violations. The results of the N-2 Transient Stability Analysis are listed in Appendix G.

7. VOLTAGE STABILITY RESULTS

The established WECC voltage stability criteria for acceptable real power (MW) margins are as follows: 5% for Category A and B outages, 2.5% for Category C, and 0% for Category D outages. PV analysis results are provided for the Category A, B, C, and D outages described in Section 3. The following is a summary of the study results. Detailed results are provided in Appendix H.

2013 HEAVY SUMMER - NO PRIOR OUTAGE

NERC Category A & B

System Intact and N-1 Voltage Stability Analysis indicated adequate voltage stability margins for the 2013 HS base case. The system intact margin was determined to be 16.0%. The N-1 outage of Comanche #3 provided the least margin (9.7%) of the Category B outages. Both are within the established voltage stability criteria.

NERC Category C

CATEGORY C	COLLAPSE POINT DATA		
OUTAGE	T3T5 IMPORT	T3T5 LOAD	MARGIN
PORTLND-WSTATN115&WCANON 115\230 OUTAGE	989.25	10546.12	Unsolved

The N-2 outage of the Portland-West Station 115 kV line and West Canon 115/230 kV transformer outage did not solve in the 2013 HS base case and therefore has no margin. Black Hills Energy is in the process of studying an additional 115 kV tie into this area.

All other Category C outages meet the established WECC Voltage Stability Criteria.

NERC Category D

CATEGORY D	COLLAPSE POINT DATA		
OUTAGE	T3T5 IMPORT	T3T5 LOAD	MARGIN
SAN LUIS 115 BUS OUTAGE	989.25	10546.12	Unsolved
WILLOW CREEK(TS) 115 BUS OUTAGE	989.25	10546.12	Unsolved
PAWNEE 230 BUS OUTAGE	989.25	10546.12	Unsolved

The San Luis 115 kV, Willow Creek 115 kV, and Pawnee 230 kV bus outages did not solve in the 2013 HS base case and therefore have no voltage stability margin. These Category D disturbances will to be further evaluated for risk and consequence.

All other Category D outages meet the established WECC Voltage Stability Criteria.

2013 HEAVY SUMMER – COMANCHE UNIT 3 PRIOR OUTAGE WITH REDISPATCH

NERC Category A & B Outages

The Comanche #3 prior outage and Category B Voltage Stability Analysis indicated adequate voltage stability margins for the 2013 HS Comanche #3 prior outage base case. The Comanche #3 prior outage margin was determined to be 15.8%. The outage of Comanche #2 provided the least margin (12.1%) of the Category B outages. Both are within the established voltage stability criteria.

NERC Category C Outages

The N-2 outage of the Portland-West Station 115 kV line and West Canon 115/230 kV transformer outage did not solve in the 2013 HS base case and therefore has no margin. Black Hills Energy is in the process of studying an additional 115 kV tie into this area.

All other Category C outages meet the established WECC Voltage Stability Criteria.

NERC Category D Outages

The San Luis 115 kV bus outage did not solve in the 2013 HS Comanche #3 prior outage base case and therefore has no voltage stability margin. This Category D disturbance will be further evaluated for risk and consequence.

All other Category D outages meet the established WECC Voltage Stability Criteria.

2013 HEAVY SUMMER - CHEROKEE UNIT 4 PRIOR OUTAGE WITH REDISPATCH

NERC Category A & B Outages

The Cherokee #4 prior outage and Category B Voltage Stability Analysis indicated adequate voltage stability margins for the 2013 HS Cherokee #4 prior outage base case. The Cherokee #4 prior outage margin was determined to be 15.3%. The outage of Comanche #3 provided the least margin (9.2%) of the Category B outages. Both are within the established voltage stability criteria.

NERC Category C Outages

The N-2 outage of the Portland-West Station 115 kV line and West Canon 115/230 kV transformer outage did not solve in the 2013 HS base case and therefore has no margin. Black Hills Energy is in the process of studying an additional 115 kV tie into this area.

All other Category C outages meet the established WECC Voltage Stability Criteria.

NERC Category D Outages

The San Luis 115 kV and Willow Creek 115 kV bus outages did not solve in the 2013 HS base case and therefore have no voltage stability margin. These Category D disturbances will be further evaluated for risk and consequence.

All other Category D outages meet the established WECC Voltage Stability Criteria.

2013 HEAVY SUMMER - PAWNEE UNIT 1 PRIOR OUTAGE WITH REDISPATCH

NERC Category A & B Outages

The Pawnee prior outage and Category B Voltage Stability Analysis indicated adequate voltage stability margins for the 2013 HS Pawnee prior outage base case. The Pawnee prior outage margin was determined to be 16.1%. The outage of Comanche #3 provided the least margin (9.6%) of the Category B outages. Both are within the established voltage stability criteria.

NERC Category C Outages

The N-2 outage of the Portland-West Station 115 kV line and West Canon 115/230 kV transformer outage did not solve in the 2013 HS Pawnee prior outage base case and therefore has no margin. Black Hills Energy is in the process of studying an additional 115 kV tie into this area.

All other Category C outages meet the established WECC Voltage Stability Criteria.

NERC Category D Outages

The San Luis 115 kV and Willow Creek 115 kV bus outages did not solve in the 2013 HS Pawnee prior outage base case and therefore have no voltage stability margin. These Category D disturbances will be further evaluated for risk and consequence.

All other Category D outages meet the established WECC Voltage Stability Criteria.

2018 HEAVY SUMMER - NO PRIOR OUTAGE

NERC Category A & B Outages

The System Intact Voltage Stability Analysis indicated adequate voltage stability margins for the 2018 HS base case. The margin was determined to be 12.1%. The outage of Cherokee #4 provided the least margin (8.6%) of the Category B outages. Both are within the established voltage stability criteria.

NERC Category C Outages

CATEGORY C	COLLAPSE POINT DATA		
OUTAGE	T3T5 IMPORT	T3T5 LOAD	MARGIN
PORTLND-WSTATN115&WCANON 115\230 OUTAGE	1060.69	12291.65	Unsolved
LAMAR-VILAS & LAMAR-WILLOW CREEK 115 OUTAGE	1060.69	12291.65	Unsolved

The N-2 outage of the Portland-West Station 115 kV line and West Canon 115/230 transformer did not solve in the 2018 HS base case and therefore has no margin. Black Hills Energy is in the process of studying an additional 115 kV tie into this area.

The N-2 outage of the Lamar-Vilas & Lamar-Willow Creek 115 kV lines did not solve in the 2018 HS base case and therefore has no margin. This Category C disturbance will be further evaluated for risk and consequence.

All other Category C outages meet the established WECC Voltage Stability Criteria.

NERC Category D Outages

CATEGORY D	COLLAPSE POINT DATA		
OUTAGE	T3T5 IMPORT	T3T5 LOAD	MARGIN
BOONE 115 BUS OUTAGE	1060.69	12291.65	Unsolved
ST.VRAIN 230 BUS OUTAGE	1060.69	12291.65	Unsolved
SAN LUIS 115 BUS OUTAGE	1060.69	12291.65	Unsolved
WILLOW CREEK(TS) 115 BUS OUTAGE	1060.69	12291.65	Unsolved

The Boone 115 kV, St. Vrain 230 kV, San Luis 115 kV, and Willow Creek 115 kV bus outages did not solve in the 2018 HS base case and therefore have no voltage stability margin. These Category D disturbances will be further evaluated for risk and consequence.

All other Category D outages meet the established WECC Voltage Stability Criteria.

2018 HEAVY SUMMER - COMANCHE UNIT 3 PRIOR OUTAGE WITH REDISPATCH

NERC Category A & B Outages

The Comanche #3 prior outage voltage stability analysis indicated adequate voltage stability margins for the 2018 HS Comanche #3 prior outage base case. The margin was determined to be 12.6%. The outage of Cherokee #4 provided the least margin (8.8%) of the Category B outages. Both are within the established voltage stability criteria.

NERC Category C Outages

The N-2 outage of the Portland-West Station 115 kV line and West Canon 115/230 transformer did not solve in the 2018 HS base case and therefore has no margin. Black Hills Energy is in the process of studying an additional 115 kV tie into this area.

The outage of the Lamar-Vilas & Lamar-Willow Creek 115 kV lines did not solve in the 2018 HS base case and therefore has no margin. This Category C disturbance will be further evaluated for risk and consequence.

All other Category C outages meet the established WECC Voltage Stability Criteria.

NERC Category D Outages

The Boone 115 kV, St. Vrain 230 kV, San Luis 115 kV, and Willow Creek 115 kV bus outages did not solve in the 2018 HS base case and therefore have no voltage stability margin. These Category D disturbances will be further evaluated for risk and consequence.

All other Category D outages meet the established WECC Voltage Stability Criteria.

2018 HEAVY SUMMER - CHEROKEE UNIT 4 PRIOR OUTAGE WITH REDISPATCH

NERC Category A & B Outages

The Cherokee #4 prior outage voltage stability analysis indicated adequate voltage stability margins for the 2018 HS Cherokee #4 prior outage base case. The margin was determined to be 10.2%. The outage of Comanche #3 provided the least margin (7.0%) of the Category B outages. Both are within the established voltage stability criteria.

NERC Category C Outages

The N-2 outage of the Portland-West Station 115 kV line and West Canon 115/230 transformer did not solve in the 2018 HS base case and therefore has no margin. Black Hills Energy is in the process of studying an additional 115 kV tie into this area.

The N-2 outage of the Lamar-Vilas & Lamar-Willow Creek 115 kV lines did not solve in the 2018 HS base case and therefore has no margin. This Category C disturbance will be further evaluated for risk and consequence.

All other Category C outages meet the established WECC Voltage Stability Criteria.

NERC Category D Outages

The Boone 115 kV, St. Vrain 230 kV, San Luis 115 kV, and Willow Creek 115 kV bus outages did not solve in the 2018 HS base case and therefore have no voltage stability margin. These Category D disturbances will be further evaluated for risk and consequence.

All other Category D outages meet the established WECC Voltage Stability Criteria.

2018 HEAVY SUMMER - PAWNEE UNIT 1 PRIOR OUTAGE WITH REDISPATCH

NERC Category A & B Outages

The Pawnee prior outage voltage stability analysis indicated adequate voltage stability margins for the 2018 HS Pawnee prior outage base case. The margin was determined to be 12.3%. The outage of Comanche #3 provided the least margin (8.3%) of the Category B outages. Both are within the established voltage stability criteria.

NERC Category C Outages

The N-2 outage of the Portland-West Station 115 kV line and West Canon 115/230 transformer did not solve in the 2018 HS base case and therefore has no margin. Black Hills Energy is in the process of studying an additional 115 kV tie into this area.

The N-2 outage of the Lamar-Vilas & Lamar-Willow Creek 115 kV lines did not solve in the 2018 HS base case and therefore has no margin. This Category C disturbance will be further evaluated for risk and consequence.

All other Category C outages meet the established WECC Voltage Stability Criteria.

NERC Category D Outages

The Boone 115 kV, St. Vrain 230 kV, San Luis 115 kV, and Willow Creek 115 kV bus outages did not solve in the 2018 HS base case and therefore have no voltage stability margin. These Category D disturbances will be further evaluated for risk and consequence.

All other Category D outages meet the established WECC Voltage Stability Criteria.

List of Study Participants

1. Basin Electric Power Cooperative
2. Black Hills Energy
3. Black Hills Power
4. Colorado Springs Utilities
5. Platte River Power Authority
6. Public Service Company of Colorado
7. Tri-State Generation and Transmission Association
8. Western Area Power Administration

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APPENDIX A

NERC / WECC TABLES

Table I. Transmission Systems Standards — Normal and Contingency Conditions

Category	Contingencies	Components Out of Service	System Limits or Impacts				
	Initiating Event(s) and Contingency Component(s)		Thermal Limits	Voltage Limits	System Stable	Loss of Demand or Curtailed Firm Transfers	Cascading ^c Outages
A - No Contingencies	All Facilities in Service	None	Normal	Normal	Yes	No	No
B - Event resulting in the loss of a single component.	Single Line Ground (SLG) or 3-Phase (3Ø) Fault, with Normal Clearing: 1. Generator 2. Transmission Circuit 3. Transformer Loss of a Component without a Fault.	Single Single Single Single	Applicable Rating ^a (A/R) A/R A/R A/R	Applicable Rating ^a (A/R) A/R A/R A/R	Yes Yes Yes Yes	No ^b No ^b No ^b No ^b	No No No No
	Single Pole Block, Normal Clearing: 4. Single Pole (dc) Line	Single	A/R	A/R	Yes	No ^b	No
C - Event(s) resulting in the loss of two or more (multiple) components.	SLG Fault, with Normal Clearing: 1. Bus Section 2. Breaker (failure or internal fault)	Multiple Multiple	A/R A/R	A/R A/R	Yes Yes	Planned ^d Planned ^d	No No
	SLG or 3Ø Fault, with Normal Clearing, Manual System Adjustments, followed by another SLG or 3Ø Fault, with Normal Clearing: 3. Category B (B1, B2, B3, or B4) contingency, manual system adjustments, followed by another Category B (B1, B2, B3, or B4) contingency	Multiple	A/R	A/R	Yes	Planned ^d	No
	Bipolar Block, with Normal Clearing: 4. Bipolar (dc) Line Fault (non 3Ø), with Normal Clearing: 5. Double Circuit Towerline	Multiple Multiple	A/R A/R	A/R A/R	Yes Yes	Planned ^d Planned ^d	No No
	SLG Fault, with Delayed Clearing: 6. Generator 7. Transmission Circuit 8. Transformer 9. Bus Section	Multiple Multiple	A/R A/R	A/R A/R	Yes Yes	Planned ^d Planned ^d	No No

Table I. Transmission Systems Standards — Normal and Contingency Conditions

<p>D^e – Extreme event resulting in two or more (multiple) components removed or cascading out of service</p>	<p>3Ø Fault, with Delayed Clearing (stuck breaker or protection system failure):</p> <ol style="list-style-type: none"> 1. Generator 2. Transmission Circuit 3. Transformer 4. Bus Section <hr/> <p>3Ø Fault, with Normal Clearing:</p> <ol style="list-style-type: none"> 5. Breaker (failure or internal fault) <hr/> <p>Other:</p> <ol style="list-style-type: none"> 6. Loss of towerline with three or more circuits 7. All transmission lines on a common right-of-way 8. Loss of a substation (one voltage level plus transformers) 9. Loss of a switching station (one voltage level plus transformers) 10. Loss of all generating units at a station 11. Loss of a large load or major load center 12. Failure of a fully redundant special protection system (or remedial action scheme) to operate when required 13. Operation, partial operation, or misoperation of a fully redundant special protection system (or remedial action scheme) for an event or condition for which it was not intended to operate 14. Impact of severe power swings or oscillations from disturbances in another Regional Council. 	<p>Evaluate for risks and consequences.</p> <ul style="list-style-type: none"> • May involve substantial loss of customer demand and generation in a widespread area or areas. • Portions or all of the interconnected systems may or may not achieve a new, stable operating point. • Evaluation of these events may require joint studies with neighboring systems. • Document measures or procedures to mitigate the extent and effects of such events. • Mitigation or elimination of the risks and consequences of these events shall be at the discretion of the entities responsible for the reliability of the interconnected transmission systems.
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Footnotes to Table I.

- a) Applicable rating (A/R) refers to the applicable normal and emergency facility thermal rating or system voltage limit as determined and consistently applied by the system or facility owner.
- b) Planned or controlled interruption of generators or electric supply to radial customers or some local network customers, connected to or supplied by the faulted component or by the affected area, may occur in certain areas without impacting the overall security of the interconnected transmission systems. To prepare for the next contingency, system adjustments are permitted, including curtailments of contracted firm (non-recallable reserved) electric power transfers.
- c) Cascading is the uncontrolled successive loss of system elements triggered by an incident at any location. Cascading results in widespread service interruption which cannot be restrained from sequentially spreading beyond an area predetermined by appropriate studies.
- d) Depending on system design and expected system impacts, the controlled interruption of electric supply to customers (load shedding), the planned removal from service of certain generators, or the curtailment of contracted firm (non-recallable reserved) electric power transfers may be necessary to maintain the overall security of the interconnected transmission systems.
- e) A number of extreme contingencies that are listed under Category D and judged to be critical by the transmission planning entity(ies) will be selected for evaluation. It is not expected that all possible facility outages under each listed contingency of Category D will be evaluated.

Table 2. WECC DISTURBANCE-PERFORMANCE TABLE OF ALLOWABLE EFFECTS ON OTHER SYSTEMS

**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		

Notes to Table 2:

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 the WECC 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% for more than 20 cycles at load buses, or exceed 25% at load buses or 30% 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 the WECC Disturbance-Performance Table for Category C disturbances, it is presumed that some planned and controlled islanding has occurred. 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.*

APPENDIX B

TRANSIENT DISTURBANCE DESCRIPTION LISTING

NERC CATEGORY A, B, C, & D

NERC CATEGORY A			
FAULTED BUS	FAULT TYPE	CLEARING TIME	CLEARED BRANCH
*** NO FAULT ***	*****	*****	*****

NERC CATEGORY B			
<u>FAULTED BUS</u>	<u>FAULT TYPE</u>	<u>CLEARING TIME</u>	<u>CLEARED BRANCH</u>
ARCHER 230	3 PHASE	5 CYCLES	ARCHER - AULT 230
ARCHER 230	3 PHASE	5 CYCLES	ARCHER - STEGALL 230
ARCHER 230	3 PHASE	5 CYCLES	ARCHER - HAYDEN 230
AULT 230	3 PHASE	5 CYCLES	AULT - ARCHER 230
AULT 230	3 PHASE	5 CYCLES	AULT - WELD 230 NO. 1
BADWTR 230	3 PHASE	5 CYCLES	BADWTR - SPENCE 230
BADWTR 230	3 PHASE	5 CYCLES	BADWTR - THERM 230
CARRDRAW 230	3 PHASE	5 CYCLES	CARRDRAW - BUFFALO 230
CARRDRAW 230	3 PHASE	5 CYCLES	CARRDRAW - HARTZOG 230
CARRDRAW 230	3 PHASE	5 CYCLES	CARRDRAW - WYODAK 230
CHEROKEE 230	3 PHASE	5 CYCLES	CHEROKEE - DENVER TERM 230
COMANCHE 345	3 PHASE	4 CYCLES	COMANCHE – DANIEL PARK 345
COMANCHE 230	3 PHASE	5 CYCLES	COMANCHE - MIDWAY 230
COMANCHE 230	3 PHASE	5 CYCLES	COMANCHE - FULLER 230
CRAIG 230	3 PHASE	5 CYCLES	CRAIG - HAYDEN 230 NO.1
CRAIG 230	3 PHASE	5 CYCLES	CRAIG - RIFLE 230
CRAIG 230	3 PHASE	5 CYCLES	CRAIG UNIT #2
CURECANT 230	3 PHASE	5 CYCLES	CURECANTI - LOSTCAN 230
CURECANT 230	3 PHASE	5 CYCLES	CURECANTI – MORROWPT 230
CURECANT 230	3 PHASE	5 CYCLES	CURECANTI - NORTHFORK 230
CURECANT 230	3 PHASE	5 CYCLES	CURECANTI - PARLIN 230
DONKEYCRK 230	3 PHASE	4.25 CYCLES	DONKEYCRK-PUMPKIN BUTTE 230
DONKEYCRK 230	3 PHASE	4.25 CYCLES	DONKEYCRK-RENO 230
DRYFORK 230	3 PHASE	4.25 CYCLES	DRY FORK-CARR DRAW 230
DRYFORK 230	3 PHASE	4.25 CYCLES	DRY FORK-HUGHES 230
DRYFORK 230	3 PHASE	4.25 CYCLES	DRY FORK-TONGUE RIVER 230
HAYDEN 230	3 PHASE	5 CYCLES	HAYDEN – ARCHER 230

NERC CATEGORY B – (CONTINUED)			
FAULTED BUS	FAULT TYPE	CLEARING TIME	CLEARED BRANCH
HAYDEN 230	3 PHASE	5 CYCLES	HAYDEN – CRAIG 230
HAYDEN 230	3 PHASE	5 CYCLES	HAYDEN – GOREPASS 230
LANGE 230	3 PHASE	5 CYCLES	LANGE – LOOKOUT 230
LANGE 230	3 PHASE	5 CYCLES	LANGE – RCSOUTH 230
LRS 345	3 PHASE	4 CYCLES	LRS – AULT 345
LRS 345	3 PHASE	4 CYCLES	LRS – STORY 345
LRS 345	3 PHASE	4 CYCLE	LRS UNIT #2
MALTA 230	3 PHASE	5 CYCLES	MALTA – MTE 230
MIDWAY 230	3 PHASE	5 CYCLES	MIDWAY – WCANON 230
PAWNEE 230	3 PHASE	5 CYCLES	PAWNEE – BRICKCTR 230
PAWNEE 230	3 PHASE	5 CYCLES	PAWNEE – DAN PARK 230
RAWHIDE 230	3 PHASE	5 CYCLES	RAWHIDE – AULT 230
RAWHIDE 230	3 PHASE	5 CYCLES	RAWHIDE – TIMBERLINE 230
RAWHIDE 230	3 PHASE	5 CYCLES	RAWHIDE UNIT #1
RD NIXON 230	3 PHASE	5 CYCLES	RD NIXON – FULLER 230kV
ST.VRAIN 230	3 PHASE	5 CYCLES	ST.VRAIN – SPNDLE 230
STEGALL 230	3 PHASE	5 CYCLES	STEGALL – ARCHER 230
STEGALL 230	3 PHASE	5 CYCLES	STEGALL – DJ 230
STEGALL 230	3 PHASE	5 CYCLES	STEGALL – WESTHILL 230
STEGALL 230	3 PHASE	5 CYCLES	STEGALL – SIDNEY 230
VALMONT 230	3 PHASE	5 CYCLES	VALMONT – SPNDLE230
WYODAK 230	3 PHASE	4.25 CYCLES	WYODAK – CARRDRAW 230
WYODAK 230	3 PHASE	4.25 CYCLES	WYODAK – DONKEYCRK 230
WYODAK 230	3 PHASE	4.25 CYCLES	WYGEN UNIT
WYODAK 230	3 PHASE	4.25 CYCLES	WYODAK – HUGHES 230
WYODAK 230	3 PHASE	4.25 CYCLES	WYODAK – OSAGE 230
YELOWTLP 230	3 PHASE	5 CYCLES	YELOWTLP – FRANNIE 230

NERC CATEGORY B – (CONTINUED)			
FAULTED BUS	FAULT TYPE	CLEARING TIME	CLEARED BRANCH
YELOWTLP 230	3 PHASE	5 CYCLES	YELOWTLP – YELLOWBR 230
COMANCHE 500	3 PHASE	4 CYCLES	COMANCHE - ENERGY CENTER 500
ENERGY CENTER 500	3 PHASE	4 CYCLES	ENERGY CENTER -COMANCHE 500
ENERGY CENTER 500	3 PHASE	4 CYCLES	ENERGY CENTER - BURLINGTON 500
BURLINGTON 500	3 PHASE	4 CYCLES	BURLINGTON - ENERGY CENTER 500
BURLINGTON 500	3 PHASE	4 CYCLES	BURLINGTON - BIG SANDY 500
BIG SANDY 500	3 PHASE	4 CYCLES	BIG SANDY - BURLINGTON 500

NERC CATEGORY C			
FAULTED BUS	FAULT TYPE	CLEARING TIME	CLEARED BRANCH
ARCHER 230	SLG	5 CYCLES	ALL ARCHER 230 BRANCHES
AULT 230	SLG	5 CYCLES	AULT – WELD 230 #1
		15 CYCLES	AULT – WELD 230 #2
BADWATER230	SLG	5 CYCLES	BADWTR – SPENCE 230
		15 CYCLES	BADWTR – THERM 230
CASPER 230	SLG	5 CYCLES	CASPER – CLAIMJPR 230
		15 CYCLES	CASPER – RIVERTON 230
CASPER 230	SLG	5 CYCLES	CASPER – CLAIMJPR 230
		15 CYCLES	CASPER – DJ 230
CHEROKEE 230	SLG	5 CYCLES	CHEROKEE – RIVERDALE 230
		15 CYCLES	CHEROKEE – GLENN 230
CHEYENNE 230	3 Phase	5 CYCLES	CHEY-AULT 230 & CHEY- OWL CRK 115
COMANCHE 230	SLG	5 CYCLES	COMANCHE – MIDWAY 230
		15 CYCLES	COMANCHE – FULLER 230
CRAIG 230	SLG	5 CYCLES	CRAIG – HAYDEN 230
		15 CYCLES	CRAIG – RIFLE 230
CRAIG 230	SLG	5 CYCLES	CRAIG – HAYDEN 230
		15 CYCLES	CRAIG 345/230
CRAIG 345	SLG	4 CYCLES	CRAIG – AULT 345
		12 CYCLES	CRAIG – CBTAP 345
CURCANTI 230	SLG	5 CYCLES	CURE – MORROW 230
		15 CYCLES	CURE – LOSTCAN 230
CURCANTI 230	SLG	5 CYCLES	CURE – MORROW 230
		15 CYCLES	CURE – NORTHFORK 230
CURCANTI 230	SLG	5 CYCLES	CURE – PARLIN 230
		15 CYCLES	CURE – NORTHFORK 230

NERC CATEGORY C – (CONTINUED)			
<u>FAULTED BUS</u>	<u>FAULT TYPE</u>	<u>CLEARING TIME</u>	<u>CLEARED BRANCH</u>
CURCANTI 230	SLG	5 CYCLES	CURE – PARLIN 230
		15 CYCLES	CURE 230/115
CURCANTI 230	SLG	5 CYCLES	CURE – LOSTCAN 230
		15 CYCLES	CURE 230/115
DONKEY CRK 230	SLG	4.25 CYCLES	DONKEY CRK-RENO 230
		12 CYCLES	WYGEN 2
DONKEY CRK 230	SLG	4.25 CYCLES	DONKEY CRK-PUMPKIN BUTTE 230
		12 CYCLES	WYGEN 3
DRAKE 115	SLG	5 CYCLE	DRAKE UNIT 7
		15 CYCLE	DRAKE-ATMELDSUB 115
DRY FORK 230	SLG	4.25 CYCLES	DRY FORK-TONGUE RVR 230
		12 CYCLES	DRY FORK-CARR DRAW 230
FULLER 230	SLG	5 CYCLES	FULLER – CTTNWD 230
		15 CYCLES	NIXON – FULLER230
HAYDEN 230 EAST BUS	SLG	5 CYCLES	EAST BUS 230 LINES
HAYDEN 230 WEST BUS	SLG	5 CYCLES	WEST BUS 230 LINES
LRS 345	SLG	4 CYCLES	LRS – AULT 345
		12 CYCLES	LRS UNIT 2
MIDWAY 230	SLG	5 CYCLES	ALL MIDWAY WAPA 230 LINES
PAWNEE 230	SLG	5 CYCLES	PAWNEE – BRICKCTR 230
		15 CYCLES	PAWNEE – DAN PARK 230
RAWHIDE 230	SLG	5 CYCLES	RAWHIDE – AULT 230
		15 CYCLES	RAWHIDE – TIMBERLINE 230
RDNIXON 230	SLG	5 CYCLES	NIXON – FULLER 230
		15 CYCLES	NIXON – ARIES 230
RDNIXON 230	SLG	5 CYCLES	NIXON – MIDWAY 230
		15 CYCLES	NIXON – ARIES 230

NERC CATEGORY C – (CONTINUED)				
FAULTED BUS		FAULT TYPE	CLEARING TIME	CLEARED BRANCH
RDNIXON 230		SLG	5 CYCLES	FRPP UNITS
			15 CYCLES	NIXON CT UNITS
RIVERTON 230		SLG	5 CYCLES	RIV – THERM 230
			15 CYCLES	RIV – WYOPO 230
STEGALL 230 BUS		SLG	5 CYCLES	STEGALL 230 LINES
ST.VRAIN 230		SLG	5 CYCLES	ST.VRAIN – FT.LUPTON 230
			15 CYCLES	ST.VRAIN – SPNDLE 230
THERMOP 230		SLG	5 CYCLES	THERM – RIVER 230
			15 CYCLES	THERM – BAD 230
WYODAK 230		SLG	4.25 CYCLES	WYGEN UNIT
			12 CYCLES	WYODAK – DONKYCRK 230
WYODAK 230		SLG	4.25 CYCLES	WYODAK – DONKYCRK 230
			12 CYCLES	WYGEN UNIT
WYODAK 230		SLG	4.25 CYCLES	WYODAK – HUGHES 230
			12 CYCLES	WYODAK – CARRDRAW 230
WYODAK 230		SLG	4.25 CYCLES	WYODAK – HUGHES 230
			12 CYCLES	WYODAK 230/69 XFMRS
WYODAK 230		SLG	4.25 CYCLES	WYODAK – OSAGE 230
			12 CYCLES	WYODAK UNIT
Y.TAIL PP230 BUS		SLG	5 CYCLES	Y.TAIL PP – Y.TAIL BR 230
			15 CYCLES	Y.TAIL PP – GOOSECRK-SHERD230
Prior Outage	Faulted Bus	FAULT TYPE	CLEARING TIME	CLEARED BRANCH
CRAIG #2	CRAIG 230	3 PHASE	5 CYCLES	CRAIG UNIT #1
LRS #2	LRS 345	3 PHASE	4 CYCLE	LRS UNIT #3
RAWHIDE #1	RAWHIDE 230	3 PHASE	5 CYCLES	RAWHIDE UNIT #F

NERC CATEGORY D			
<u>FAULTED BUS</u>	<u>FAULT TYPE</u>	<u>CLEARING TIME</u>	<u>CLEARED BRANCH</u>
AULT 345	3 PHASE	4 CYCLES	ALL AULT 345
AULT 230	3 PHASE	5 CYCLES	ALL AULT 230
BEARS EARS 345	3 PHASE	4 CYCLES	ALL BEARS EARS 345
CRAIG 345	3 PHASE	4 CYCLES	ALL CRAIG 345
CRAIG 345	3 PHASE	4 CYCLES	CRAIG-AULT 345 & HAYDEN-ARCH 230
CRAIG 230	3 PHASE	5 CYCLES	ALL CRAIG 230
DANIEL PARK 230	3 PHASE	5 CYCLES	ALL DANIEL PARK 230
DJ 230	3 PHASE	5 CYCLES	ALL DJ 230
DONKEY CRK 230	3 PHASE	5 CYCLES	ALL DONKEY CRK 230
DRY FORK 230	3 PHASE	5 CYCLES	ALL DRY FORK 230
HAYDEN 230	3 PHASE	5 CYCLES	ALL HAYDEN 230
LRS 345	3 PHASE	4 CYCLES	ALL LRS 345
LRS 230	3 PHASE	5 CYCLES	ALL LRS 230
MIDWAY 230	3 PHASE	5 CYCLES	ALL MIDWAY 230
PAWNEE 230	3 PHASE	5 CYCLES	ALL PAWNEE 230
RAWHIDE 230	3 PHASE	5 CYCLES	ALL RAWHIDE 230
RD NIXON 230	3 PHASE	5 CYCLES	ALL RD NIXON 230
RIFLE 345	3 PHASE	4 CYCLES	ALL RIFLE 345
ST.VRAIN 230	3 PHASE	5 CYCLES	ALL ST.VRAIN 230
WATERFLOW (SANJN PS) 345	3 PHASE	4 CYCLES	ALL WATERFLOW 345
WELD LM 230	3 PHASE	5 CYCLES	ALL WELD LM 230
WYODAK 230	3 PHASE	5 CYCLES	ALL WYODAK 230

APPENDIX C

STEADY STATE OUTAGE LISTING

NERC CATEGORY A, B, C, & D

NERC CATEGORY A – OUTAGE DESCRIPTION

- SYSTEM INTACT

NERC CATEGORY B – OUTAGE DESCRIPTION

- ALL BRANCHES OPERATED AT 115KV OR GREATER IN CCPG AREA

NERC CATEGORY C – OUTAGE DESCRIPTION

1. WYODAK – HUGHES 230KV & WYODAK-CARRDRAW 230KV OUTAGE; WYODAK 1H326 FAILURE
2. WYODAK – HUGHES 230KV & HUGHES – LOOKOUT 230KV OUTAGE
3. LOOKOUT – HUGHES 230KV & LOOKOUT – YELLOWCREEK 230KV OUTAGE
4. WESTHILL – SOUTHRC 230KV & WESTHILL – OSAGE 230KV OUTAGE
5. WESTHILL – STEGALL 230KV & WESTHILL – OSAGE 230KV OUTAGE
6. WYODAK – DONKEY CREEK 230KV & WYGEN UNIT OUTAGE
7. WYODAK – OSAGE 230KV & WYODAK UNIT OUTAGE; WYODAK 1H334 FAILURE
8. DRY FORK – CARR DRAW & DRY FORK-TONGUE RIVER 230 KV OUTAGE
9. LOSS OF ARCHER 230KV MAIN BUS – BREAKER FAILURE SLG
10. CRAIG – CBTAP 345KV & CRAIG-AULT 345KV OUTAGE; CRAIG 896 FAILURE
11. LRS – AULT 345KV & LRS UNIT 3 OUTAGE; LRS 2996 FAILURE
12. RAWHIDE – AULT 230KV & RAWHIDE – TIMBERLINE 230KV OUTAGE; DOUBLE CIRCUIT TOWER
13. NIXON – FULLER 230KV & NIXON-ARIES 230KV OUTAGE
14. DRAKE S - KEKLER W 115KV & DRAKE N – ATMELSUB115KV OUTAGE
15. KELKER E - TEMPLTON 115KV & KELKER W – ROCKISLD 115KV OUTAGE
16. KELKER E – TEMPLTON 115KV & TEMPLTON – ROCKISLD 115KV OUTAGE
17. FULLER – CTTNWD 230KV & NIXON – FULLER 230KV OUTAGE
18. AULT – WELD 230KV #1 & #2 DOUBLE CIRCUIT OUTAGE
19. BADWATER – SPENCE 230KV & BADWATER – THERM 230KV OUTAGE; BADWATER 1184 FAILURE
20. CRAIG – HAYDEN 230KV & CRAIG – RIFLE 230KV OUTAGE; CRAIG 886 FAILURE
21. CRAIG – HAYDEN 230KV #2 & CRAIG 345/230KV OUTAGE; CRAIG 286 FAILURE
22. CURCANTI - MORROW 230KV & CURECANTI-LOSTCAN 230KV OUTAGE; CURECANTI 1082 FAILURE
23. CURCANTI - MORROW 230KV & CURECANTI – NORTHFORK 230KV OUTAGE; CURECANTI 682 FAILURE
24. CURCANTI - PARLIN 230KV & CURECANTI – NORTHFORK 230KV OUTAGE; CURECANTI 786 FAILURE
25. CURCANTI – PARLIN 230KV & CURECANTI 230/115KV OUTAGE; CURECANTI 882 FAILURE
26. CURCANTI – LOSTCAN 230KV & CURECANTI 230/115KV OUTAGE; CURECANTI 1282 FAILURE
27. HAYDEN 230KV EAST MAIN BUS – BREAKER FAILURE SLG
28. HAYDEN 230KV WEST MAIN BUS – BREAKER FAILURE SLG

NERC CATEGORY C – OUTAGE DESCRIPTION - CONTINUED

29. STEGALL 230KV MAIN BUS – BREAKER FAILURE SLG
30. Y.TAILBR - Y.TAILPP 230KV & Y.TAIL – GOOSE 230KV OUTAGE; Y.TAILPP 1H296 FAILURE
31. DJ – SPENCE 230KV & DJ – CASPER 230KV DOUBLE CIRCUIT OUTAGE
32. DJ – SPENCE 230KV & DJ – YELLOW 230KV OUTAGE; DJ 1H212 FAILURE
33. CASPER – CLAIMJPR 230KV & CASPER – RIVERTON 230KV OUTAGE
34. CASPER – CLAIMJPR 230KV & CASPER – DJ 230KV OUTAGE
35. RIVERTON – THERM 230KV & RIVERTON – WYOPO 230KV OUTAGE; RIVERTON 1H112 FAILURE
36. THERM – RIVERTON 230KV & THERM – BADWATER 230KV OUTAGE; THERM 1H224 FAILURE
37. AULT – LRS 345KV & AULT345/230KV OUTAGE
38. CRAIG – AULT 345KV & AULT345/230KV OUTAGE
39. AULT – ARCHER 230KV & AULT345/230KV OUTAGE
40. AULT – WELD 230KV & AULT 345/230KV OUTAGE
41. AULT – WELD 230KV & AULT-RAWHIDE 230KV OUTAGE
42. AULT - ST.VRAIN 230KV & AULT – TIMBERLINE 230KV OUTAGE
43. AULT – RAWHIDE 230KV & AULT - TIMBERLINE 230KV OUTAGE
44. TIMBERLINE – RAWHIDE 230KV & TIMBERLINE – AULT 230KV OUTAGE
45. ST.VRAIN - FT.LUPTON CKTS #1 & #2 230KV OUTAGE
46. LONGPEAK – BOYD230 KV & LONGPEAK 230/115KV OUTAGE
47. LONGPEAK 230/115KV & LONGPEAK - TERRY115KV OUTAGE
48. LONGPEAK 230/115KV & LONGPEAK – DELCAM 115KV OUTAGE
49. ST.VRAIN – LONGPEAK 230KV & STVRAIN – ISABELLE 230KV OUTAGE
50. CHEROKEE – RIVERDALE, RIVERDALE – HENRY LAKE, & CHEROKEE – SILVER SADDLE 230KV OUTAGE
51. COMANCHE – MIDWAY 230KV & COMANCHE – FULLER 230KV OUTAGE
52. PAWNEE – BRICKCTR, QUINCY – SMOKY HILL, & PAWNEE - DANPARK 230KV OUTAGE
53. ST.VRAIN – NIWOT, & ST.VRAIN – SPNDLE 230KV OUTAGE
54. CABIN CREEK – LOOKOUT & CABIN CREEK– IDAHO SPRINGS- LOOKOUT 230KV OUTAGE
55. COMANCHE – MIDWAY CKTS #1 & #2 230KV OUTAGE
56. SMOKY HILL – SPRUCE CKTS #1 & #2 230KV OUTAGE
57. BOONE – DOT TAP & MIDWAY – NORTHRIDGE 115KV
58. CANON CITY – WEST CANON & COMANCHE – READER 115KV OUTAGE
59. PORTLAND – WEST STATION 115KV & WEST CANON XFMR OUTAGE
60. BOONE – DOT TAP & COMANCHE – READER 115 KV OUTAGE
61. LOSS OF LRS UNIT #2, SYSTEM READJUSTED FOLLOWED BY LOSS OF LRS UNIT #3
62. LOSS OF CRAIG UNIT G2, SYSTEM READJUSTED FOLLOWED BY LOSS OF CRAIG UNIT G3
63. CHEYENNE – AULT 230-KV, CHEYENNE – OWL CREEK 115-KV DOUBLE CIRCUIT OUTAGE
64. NIXON # 1 & ALL FRPP UNITS OUTAGE
65. COTTONWOOD TRANSFORMERS #1 & #2 OUTAGE
66. KELKER TRANSFORMERS #1 & #2 OUTAGE
67. RMEC – GREENVAL 230 KV & RMEC – KEENSBG 230 KV OUTAGE

NERC CATEGORY C – OUTAGE DESCRIPTION – CONTINUED

- 68. FTLUPTON – HENRYLAKE 230 & FTLUPTON – GREENVAL 230 KV OUTAGE
- 69. GREENVAL – FTLUPTON 230 & GREENVAL – BARRLAKE 230 KV OUTAGE
- 70. PLAINS END – NIWOT 230 & PLAINS END – VALMONT 230 OUTAGE
- 71. LOOKOUT- PLAINS END #1 & #2 230 KV OUTAGE
- 72. DANIELPK - COMANCHE #1 & #2 345 KV OUTAGE
- 73. MIDWAYPS – WATERTON 345 & DANIELPK-FULLER 230 KV OUTAGE
- 74. DANIELPK – SANTEFE 230 & DANIELPK – MARCY 230 KV OUTAGE
- 75. ARCHER-HAYDEN & GORE-HAYDEN 230 OUTAGE
- 76. ARCHER-HAYDEN & GORE-HAYDEN 138 OUTAGE
- 77. ARCHER-HAYDEN & AXIAL-HAYDEN OUTAGE
- 78. ARCHER-HAYDEN & ARTESIA-HAYDEN OUTAGE
- 79. AULT-CRAIG, AX-HAYDN & CRAIG-HAYDEN OUTAGE
- 80. ARCHER-HAYDN, AULT-CRAIG & CRAIG-HAYDEN OUTAGE
- 81. AULT-CRAIG, CRAIG-HAYDN & HAYDEN-WOLC OUTAGE
- 82. AULT-CRAIG,GORE-HAYDEN 230 & HAYDEN-WOLC OUTAGE
- 83. AULT-CRAIG,GORE-HAYDEN 138 & HAYDENDN-STEAMBOAT OUTAGE
- 84. AULT-RAWHIDE,AULT-TIMBERLINE & RAWHIDE-TIMBERLINE OUTAGE
- 85. AULT-ST VRAIN & WELD-WINDSOR OUTAGE
- 86. BEARS-BONANZA & BONANZA XFMR OUTAGE (BONANZA CB B-3438 FAILURE)
- 87. BEARS-BONANZA-MONA 345 OUTAGE (BONANZA CB B-3443 FAILURE)
- 88. BEARS-CRAIG & CRAIG XFMR 1 OUTAGE (CRAIG CB 311K FAILURE)
- 89. STORY-PAWNEE & STORY XFMR OUTAGE (STORY CB 286 FAILURE)
- 90. TWO STORY TRANSFORMERS OUTAGE (STORY CB 586 FAILURE)
- 91. BIG SANDY-BURLINGTON & BIG SANDY XFMR OUTAGE (BIG SANDY CB 286 FAILURE)
- 92. BIG SANDY-MIDWAY & BIG SANDY XFMR OUTAGE (BIG SANDY CB 586 FAILURE)
- 93. MIDWAY-BIG SANDY-BURLINGTON 230 OUTAGE (BIG SANDY CB 382 FAILURE)
- 94. BLUE R-GORE PASS & GORE XFMR OUTAGE (GORE PASS CB 1186 FAILURE)
- 95. BLUE R-GORE PASS-HAYDEN 230 OUTAGE (GORE PASS CB 1282 FAILURE)
- 96. BODO-HEPERUS, CASCSD-HEPERUS, DURANGO-GLADE OUTAGE
- 97. BONANZA-MONA & BONANZA XFMR OUTAGE (BONANZA CB B-3219 FAILURE)
- 98. BONNY-BURLINGTON-BURLKC 115 OUTAGE (BURLINGTON CB 766 FAILURE)
- 99. BOONE-COMANCHE & BOONE XFMR OUTAGE (BOONE CB 5415 FAILURE)
- 100. BOONE-MIDWAY & BOONE XFMR OUTAGE (BOONE CB 5335 FAILURE)
- 101. COMANCHE-BOONE-LAMAR 230 OUTAGE (BOONE CB 5337 FAILURE)
- 102. BOONE-LAMAR & BOONE-LAJUNTA (TS) OUTAGE
- 103. MIDWAY-BOONE-LAMAR 230 OUTAGE (BOONE CB 5336 FAILURE)
- 104. BOONE-LAJUNTA (TS & WPE) 115 OUTAGE
- 105. BOYD-LONE TREE & BOYD-LONGS PEAK OUTAGE
- 106. BOYD-LONGS PEAK & DEL CAMINO TAP-MEADOW OUTAGE

NERC CATEGORY C – OUTAGE DESCRIPTION - CONTINUED

107 BOTH BURLINGTON GENERATORS OUTAGE (BURLINGTON CB 466 FAILURE)
108 CASPER-DJ & DJ UNIT 4 OUTAGE (DAVE JOHNSTON CB IH238 FAILURE)
109 COMAN UNIT 1 & COMAN XFMR 1 OUTAGE (COMANCHE CB 5406 FAILURE)
110 COMAN-WALSENB & COMAN XFMR 2 OUTAGE
111 COMANCHE-MIDWAY-DANIELS PARK OUTAGE (MIDWAY CB 5124 FAILURE)
112 CRAIG UNIT 3 & CRAIG XFMR 1 OUTAGE (CRAIG CB 321K FAILURE)
113 CRAIG UNIT 2 & CRAIG XFMR 2 OUTAGE (CRAIG CB 221K FAILURE)
114 CRAIG-HAYDEN & HAYDEN-WOLCOTT 230 OUTAGE
115 CRAIG-RIFLE-GRAND JUNCTION 345 OUTAGE (RIFLE CB 321K FAILURE)
116 CURECANTI-LOST CANYON-SHIP OUTAGE (LOST CANYON CB 5321 FAILURE)
117 CURECANTI-PONCHA-MIDWAY 230 OUTAGE (PONCHA CB 386 FAILURE)
118 CURECANTI-PONCHA-SAN LUIS 230 OUTAGE (PONCHA CB 586 FAILURE)
119 CURECANTI-LOST CANYON & HESPERUS-MONTROSE OUTAGE
120 DJ-STEGALL & DJ XFMR OUTAGE (DAVE JOHNSTON CB IH204 FAILURE)
121 DJ-LRS & DJ UNIT 3 OUTAGE (DAVE JOHNSTON CB IH268 FAILURE)
122 DJ-LRS & LRS XFMR OUTAGE (LARAMIE RIVER CB 386 FAILURE)
123 DJ-LRS-STEGALL 230 OUTAGE (LARAMIE RIVER CB 382 FAILURE)
124 NORTH YUMA-WAUNETA & NORTH YUMA XFMR OUTAGE (NORTH YUMA CB 1266 FAILURE)
125 DEERING L-NORTH YUMA-RED WILLOW OUTAGE (NORTH YUMA CB 1362 FAILURE)
126 FRASER-WINDY GAP-KREMMLING 138 OUTAGE (WINDY GAP CB 972 FAILURE)
127 FRASER-WINDY GAP & WINDY GAP XFMR OUTAGE (WINDY GAP CB 876 FAILURE)
128 BLUE R-GORE PASS & GORE PASS XFMR OUTAGE (GORE PASS CB 1186 FAILURE)
129 GORE PASS XFMRs OUTAGE (GORE PASS CB 172 FAILURE)
130 GORE PASS-HAYDEN 138 & GORE PASS XFMR OUTAGE (GORE PASS CB 472 FAILURE)
131 GORE PASS-WINDY GAP & GORE PASS XFMR OUTAGE (GORE PASS CB 276 FAILURE)
132 HAYDEN-GORE PASS-KREMMLING OUTAGE (GORE PASS CB 576 FAILURE)
133 WINDY GAP-GORE PASS-KREMMLING OUTAGE (GORE PASS CB 372 FAILURE)
134 GORE PASS-WINDY GAP & KREMMLING-WINDY GAP OUTAGE
135 GORE PASS-WINDY GAP-NCWCD 138 OUTAGE (WINDY GAP CB 576 FAILURE)
136 GORE PASS-WINDY GAP & WINDY GAP XFMR OUTAGE (WINDY GAP CB 772 FAILURE)
137 GRAND JUNCTION-MONTROSE & GRAND JUNCTION XFMR OUTAGE (GRAND JUNCTION CB 331K FAILURE)
138 GRAND JUNCTION -RIFLE & GRAND JUNCTION XFMR OUTAGE (GRAND JUNCTION CB 331K FAILURE)
139 GRAND JUNCTION-MONTROSE 345 & 115 OUTAGE
140 GRAND JUNCTION -RIFLE & RIFLE XFMR OUTAGE (RIFLE CB 311K FAILURE)
141 MONTROSE- GRAND JUNCTION -RIFLE 345 OUTAGE (GRAND JUNCTION CB 331S FAILURE)
142 GRAND JUNCTION-MONTROSE-HESPERUS 345 OUTAGE
143 GRAND JUNCTION-MONTROSE & MONTROSE XFMR OUTAGE (MONTROSE CB M311 FAILURE)
144 HESPERUS-MONTROSE & HESPERUS XFMR OUTAGE (HESPERUS CB 321N FAILURE)
145 HESPERUS-MONTROSE & DURANGO-LOST CANYON OUTAGE

NERC CATEGORY C – OUTAGE DESCRIPTION - CONTINUED

- 146 HESPERUS-MONTROSE & MONTROSE XFMR OUTAGE (MONTROSE CB M321 FAILURE)
- 147 HESPERUS-MONTROSE & MONTROSE-NUCLA OUTAGE
- 148 HESPERUS-WATERFLOW & HESPERUS XFMR OUTAGE (HESPERUS CB 321K FAILURE)
- 149 N/A
- 150 KREMMLING-WINDY GAP-NCWCD 138 OUTAGE (WINDY GAP CB 672 FAILURE)
- 151 LAMAR-VILAS & LAMAR-WILLOW CREEK 115 OUTAGE
- 152 LRS UNIT 1 & LRS XFMR OUTAGE (LARAMIE RIVER CB 2992 FAILURE)
- 153 LRS UNIT 2 & LRS XFMR OUTAGE (LARAMIE RIVER CB 2992 FAILURE)
- 154 LRS UNIT 1 & LRS-STORY OUTAGE (LARAMIE RIVER CB 2796 FAILURE)
- 155 LOST CANYON-SHIPROCK & LOST CANYON XFMR OUTAGE (LOST CANYON CB 3331 FAILURE)
- 156 MIDWAY-PONCHA-SAN LUIS 230 OUTAGE (PONCHA CB 1186 FAILURE)
- 157 NORTH YUMA -SIDNEY & NORTH YUMA XFMR OUTAGE (NORTH YUMA CB 582 FAILURE)
- 158 NORTH YUMA -STORY & NORTH YUMA XFMR OUTAGE (NORTH YUMA CB 882 FAILURE)
- 159 DEER LAKE- NORTH YUMA & NORTH YUMA XFMR OUTAGE (NORTH YUMA CB 1566 FAILURE)
- 160 SIDNEY- NORTH YUMA -WRAY 230 OUTAGE (NORTH YUMA CB 686 FAILURE)
- 161 STORY- NORTH YUMA -WRAY 230 OUTAGE (NORTH YUMA CB 782 FAILURE)
- 162 STORY-NORTH YUMA & STORY XFMR 1 OUTAGE (STORY CB 886 FAILURE)
- 163 LRS-STEGALL-SIDNEY 230 BUS OUTAGE (STEGALL CB 7092 FAILURE)
- 164 LRS-STEGALL & STEGALL XFMR OUTAGE (STEGALL CB 7196 FAILURE)
- 165 SIDNEY-STEGAL & STEGAL XFMR OUTAGE (STEGALL CB 7292 FAILURE)

NERC CATEGORY D – OUTAGE DESCRIPTION

1. CRAIG-AULT 345KV & HAYDEN-ARCHER 230KV OUTAGE
COMMON CORRIDOR
2. LRS 345KV BUS OUTAGE
LOSS OF STATION
3. PAWNEE 230KV BUS OUTAGE
LOSS OF STATION
4. DANIEL PARK 230KV BUS OUTAGE
LOSS OF STATION
5. MIDWAY WAPA 230KV BUS OUTAGE
LOSS OF STATION
6. CRAIG 345KV BUS OUTAGE
LOSS OF STATION
7. AULT 345KV BUS OUTAGE
LOSS OF STATION
8. RIFLE 345KV BUS OUTAGE
LOSS OF STATION
9. DJ 230KV BUS OUTAGE
LOSS OF STATION
10. WYODAK 230KV BUS OUTAGE
LOSS OF STATION
11. CHEROKEE
LOSS OF ALL 115KV & GENERATION
12. LOOKOUT 230KV BUS OUTAGE
LOSS OF STATION
13. SOUTHRC – LANGE 230KV & SOUTHRC – WESTHILL 230KV OUTAGE & SOUTHRC XFRM OUTAGE
14. LANGE – LOOKOUT 230KV & LANGE – SOUTHRC 230KV OUTAGE & LANGE XFMR OUTAGE
15. BOONE 115kv BUS OUTAGE
LOSS OF STATION
16. LRS 230-KV BUS OUTAGE
LOSS OF STATION
17. BEARS EARS 345-KV BUS OUTAGE
LOSS OF STATION
18. CRAIG 230-KV BUS OUTAGE
LOSS OF STATION
19. AULT 230-KV BUS OUTAGE
LOSS OF STATION
20. HAYDEN 230-KV BUS OUTAGE
LOSS OF STATION

NERC CATEGORY D – OUTAGE DESCRIPTION - CONTINUED

- 21 WATERFLOW 345-KV BUS OUTAGE (SAN JUAN PS)
LOSS OF STATION
- 22 WELD 230-KV BUS OUTAGE (WAPA & PSCO)
LOSS OF STATION
- 23. NIXON 230 KV BUS OUTAGE
LOSS OF STATION
- 24. DRAKE 115 KV BUS OUTAGE
LOSS OF STATION
- 25 RAWHIDE 230KV BUS OUTAGE
LOSS OF STATION
- 26 ST.VRAIN 230KV BUS OUTAGE
LOSS OF STATION
- 27 ARCHER 115 MAIN BUS OUTAGE
LOSS OF STATION
- 28 AXIAL BASIN 138 BUS OUTAGE
LOSS OF STATION
- 29 BAYFIELD 115 BUS OUTAGE
LOSS OF STATION
- 30 BEAVER CREEK 115 OUTAGE
LOSS OF STATION
- 31 BIG SANDY 115 BUS OUTAGE
LOSS OF STATION
- 32 CAHONE 115 BUS OUTAGE
LOSS OF STATION
- 33 CHEYENNE 115 BUS OUTAGE
LOSS OF STATION
- 34 EMPIRE 115 BUS OUTAGE
LOSS OF STATION
- 35 GRAND JUNCTION 230 BUS OUTAGE
LOSS OF STATION
- 36 GRAND JUNCTION 138 BUS OUTAGE
LOSS OF STATION
- 37 HAYDEN 138 BUS OUTAGE
LOSS OF STATION
- 38 LAJUNTA(TS) 115 BUS OUTAGE
LOSS OF STATION
- 39 LOST CANYON 115 BUS OUTAGE
LOSS OF STATION

NERC CATEGORY D – OUTAGE DESCRIPTION - CONTINUED

- 40 MEEKER 138 BUS OUTAGE
LOSS OF STATION
- 41 MIDWAYPS 115 BUS OUTAGE
LOSS OF STATION
- 42 MONTROSE 115 BUS OUTAGE
LOSS OF STATION
- 43 NUCLA 115 BUS OUTAGE
LOSS OF STATION
- 44 PONCHA 115 BUS OUTAGE
LOSS OF STATION
- 45 RANGELY 138 BUS OUTAGE
LOSS OF STATION
- 46 RIFLE 230 BUS OUTAGE
LOSS OF STATION
- 47 RIFLE 138 BUS OUTAGE
LOSS OF STATION
- 48 SAN LUIS 115 BUS OUTAGE
LOSS OF STATION
- 49 SIDNEY 230 BUS OUTAGE
LOSS OF STATION
- 50 SIDNEY 115 BUS OUTAGE
LOSS OF STATION
- 51 STEGALL 115 BUS OUTAGE
LOSS OF STATION
- 52 STEM BEACH 115 BUS OUTAGE
LOSS OF STATION
- 53 WALSENBURG 115 BUS OUTAGE
LOSS OF STATION
- 54 WILLOW CREEK(TS) 115 BUS OUTAGE
LOSS OF STATION
- 55 WRAY 115 BUS OUTAGE
LOSS OF STATION

Additional appendices are available upon request from Shawn Carlson.
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