CRITERIA

NPPD utilized applicable *NERC Transmission System Planning Performance Requirements (TPL-001-4) Table 1* contingencies to test for the adequacy and security of the NPPD transmission system. Following are the summary definitions of the NERC Transmission Planning Standards Table 1.

Normal Conditions:	Table 1 Planning Event P0
Loss of a Single Element:	Table 1 Planning Event P1 and P2
Loss of two (or more) Elements:	Table 1 Planning Event P3, P4, P5, P6, and P7
Select Extreme Events:	Table 1 Planning Event EE

For P1 and P2 contingency analysis, all single element outages were performed and evaluated. For P3-P7 and Extreme Event contingency analysis, it is impossible to anticipate or test for all possible contingencies that could adversely affect the NPPD transmission system because of the very large number of such contingencies. Therefore, the planning criteria and related contingency tests outlined in this report do not represent an exhaustive set of system operating conditions, transfer levels, and specific contingencies. Instead, they constitute an effective and practical means to stress the study area transmission system, testing its performance over the entire spectrum of possible contingencies and identifying potential weaknesses and problems. In addition contingencies from past studies and events were also performed. NPPD Transmission Planning made the decision on the criteria for which conditions, contingencies and sensitivities would be used in this assessment.

The steady-state contingency analysis also included the simulation of a large number of multiple element contingency pairs (N-2) intended to simulate P3/P6 contingencies without manual system readjustments following the initial contingency. The results of this analysis provides information which may indicate areas where prior outage limitations may require the need for system improvements or the implementation of operating guides.

The following criteria were used for the Steady-State Assessment:

Facility Loading Criteria:

Overloads of equipment are defined as greater than 100% of the normal continuous rating (Rate A). A short-term emergency rating may be utilized for a period of less than 30 minutes during which the facility must be returned to normal operating limits. Short-term emergency ratings are determined in accordance with NPPD's Facility Rating Methodology.

Any branches and/or transformers with short-term emergency ratings less than the default ratings defined within NPPD's Facility Rating Methodology are evaluated at the appropriate Emergency rating. These ratings may include facilities and ratings that are limited by protection settings (PRC-023) or relay loadability limits.

Voltage Criteria:

Normal steady-state voltage levels are defined as 0.95 to 1.05 p.u. Emergency steady-state voltage levels are defined as 0.90 – 1.10 p.u. and may be utilized for less than 30 minutes.

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Deviation Criteria:

Voltage deviations are considered acceptable within ±10% of nominal voltage.

The following criteria were used for the Stability Assessment:

Transient Voltage Criteria:

Bus voltage excursions outside the band of 0.70 to 1.2 PU any time after the fault is cleared is considered unacceptable.

Damping Criteria:

All significant machine rotor angle oscillations must be positively damped and meet the criteria below. The criteria does not apply to bus voltages. The Damping Factor will be calculated from the "Successive Positive Peak Ratio" (SPPR) of the peak-to-peak amplitude of the rotor oscillation. SPPR and the associated Damping Factor will be calculated as:

SPPR = Successive swing amplitude / Previous swing amplitude
Damping Factor = (1 - SPPR) * 100 (in %)

The Damping Criteria requires adherence to one of the following SPPR calculations:

$$\text{SPPR1} = \frac{\text{Peak Rotor Angle of 2}^{\text{nd}}\text{ Positive Peak minus Minimum Value}}{\text{Peak Rotor Angle of 1}^{\text{st}}\text{ Positive Peak minus Minimum Value}} \leq 0.95$$

Damping Factor % = (1- SPPR1) x 100% $\geq$ 5 %

$$\text{SPPR5} = \frac{\text{Peak Rotor Angle of 6}^{\text{th}}\text{ Positive Peak minus Minimum Value}}{\text{Peak Rotor Angle of 1}^{\text{st}}\text{ Positive Peak minus Minimum Value}} \leq 0.774$$

Damping Factor % = (1- SPPR5) x 100% $\geq$ 22.6 %

Post-Disturbance Loading Criteria:

Post-disturbance loading criteria is the same as the steady-state criteria previously defined.

Post-Disturbance Voltage Criteria:

Post-disturbance voltage criteria is the same as the steady-state criteria previously defined.

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