



~~2014 - 2015~~ NTTG Study Plan
for the
2014 - 2015 Public Policy Consideration Scenario
Analysis

~~Performed By:~~
~~Kim McClafferty~~
~~Chelsea Loomis~~
~~NTTG TWG~~

NTTG Study Plan
for the
2014 - 2015 Public Policy Consideration Scenario ~~RNP Public Policy Request~~
Study Plan

Table of Contents

| | |
|--|----|
| Table of Contents | 2 |
| 1. Executive Summary | 3 |
| 2. Study Assumptions | 3 |
| 3. Base cases | 43 |
| 4. Power Flow Analysis/Study Criteria | 43 |
| Steady-State (N-0)Conditions | 54 |
| Single Contingencies (N-1) | 54 |
| Credible Double Contingencies (N-2)..... | 64 |
| Performance Criteria | 65 |
| Performance Violation Mitigation Method..... | 75 |
| 5. Results Reporting | 85 |
| 1. Executive Summary | 3 |
| 2. Study Assumptions | 3 |
| 3. Base cases | 4 |
| 4. Power Flow Analysis/Study Criteria | 4 |
| Steady-State Conditions..... | 4 |
| Contingency Conditions | 4 |
| Contingencies | 4 |
| Performance Criteria | 5 |
| Limitations..... | 5 |

1. Executive Summary

~~Under FERC Order 1000 requirements, while regional transmission plans shall consider Public Policy Requirements and non-transmission alternatives, this particular study is centered more closely with Public Policy Considerations. These considerations are those that are not established by local, state, or federal laws or regulations.~~

~~During Quarter 1 of the NTTG 2014-2015 Regional Planning Cycle, stakeholders may submit regional transmission needs and associated facilities driven by public policy to be evaluated as part of the preparation of the Draft Regional Transmission plan. In the Regional Planning Cycle, the Planning Committee will determine if there is a more efficient or cost-effective regional solution to meet the transmission needs.~~

~~The Renewable Northwest Project ("RNP") has submitted a Public Policy Consideration (defined in the NTTG Funder's Attachment K) request for a scenario analysis study for the NTTG 2014-15 ten-year transmission planning cycle. This study plan outlines the study process that the Northern Tier Transmission Group ("NTTG") study process will follow to assess an accelerated phase-out of coal plants while developing utility-scale renewable resources or more specifically, the 2020 retirement of Colstrip Power Plant ("Colstrip") units 1 and 2 and replacing them with integration of with Montana replacement wind resources at the Broadview substation in the year 2020. With respect to Public Policy Considerations, RNP's request will be a separate scenario or sensitivity case. The results of the analysis may inform the 2014 - 2015 and future Regional Transmission Plans, but will not result in the inclusion of additional projects in the 2014 - 2015 Regional Transmission Plan.~~

~~This request is for NTTG to investigate a proposed targeted reduction in carbon emissions with maximum delivery of renewable energy replacing the displaced coal plant energy. This will be utilized without the construction of new transmission facilities.~~

2. Study Assumptions

Request from RNP: Retire Colstrip units 1 & 2 (305 MW net per generator after accounting for auxiliary load) and replace with 610 MW of wind in Montana.

Assumptions:

- 100% of the 610 MW will be exported on Path 8.
- The 610 MW of new wind at Broadview substation will be modeled as two 305 MW wind farms; the entirety of one farm can be tripped at a time.
- The wind farms are connected to the Broadview 500kV transmission bus through radial feeds.

- This change occurs in 2020, and
- No new transmission lines or facilities, beyond those already planned for operations in the year 2020 will be considered.
- For any contingency that results in a loss of generation, generators in the Western Interconnection will be re-distributed according to their participation factor to account for the loss.
-

3. Base cases

Two of the five base cases that were derived for use for studies in the 10-year NTTG Regional Biennial Study Transmission Plan development will be used for the PPC analysis. planning cycle.

Using the TEPPC 2024 common case production cost model and the GridView production cost software, the hourly data for several system conditions was identified. The resulting cases are:

- Summer Peak (peak coincident NTTG summer load condition), and the
- NW-MT Case (additional system conditions to meet the needs of Path 8 in the NTTG footprint high slow condition).), and the
- Summer Peak (peak coincident NTTG summer load condition).

For each of the selected base cases, there will be three scenarios:

- No changes to Colstrip, this case will be considered the "baseline."
- Both Colstrip units 1 and 2 offline, and
- Both Colstrip units 1 and 2 offline with the addition of the 610 MW wind at the Broadview substation.
- For any contingency that results in a loss of generation, generators in the Western Interconnection will be re-distributed according to their participation factor to account for the loss.
-

4. Power Flow Analysis/Study Criteria

Power flow studies will be evaluated under steady-state (N-0), single (N-1) and credible double contingency (N-2) conditions to ensure the submitted project transmission system request meets the system performance requirements defined in the planning standards.

Steady-State (N-0) Conditions

Under steady-state conditions, bus voltages must be maintained between 0.95 p.u. and 1.05 p.u., unless specific minimum operating voltage requirements exist. All line and transformer loadings must be below normal continuous ratings. ~~Should a contingency cause thermal overloads, then an exploration of tripping either wind, coal or a combination of both will take place to alleviate the overload(s). It is assumed at this time that the tripping of either wind, coal or a combination of both will completely alleviate any overloads that may be observed during the study. The amount of generation tripped will be based on expected responses based on NWE's experience with the ATR.~~

~~Contingency Conditions~~

- ~~Changes in bus voltages are allowed provided they remain above 0.9 p.u. and below 1.1 p.u. Changes in bus voltages from pre to post contingency conditions must be less than 5% for single (N-1) contingencies, and 10% for double (N-2) contingencies for neighboring regions.~~
- ~~All equipment must be at or below their normal ratings under normal system conditions.~~
- ~~All line, series capacitors, and transformer loadings must be at or below their emergency rating (or normal rating if no emergency rating is given), for both N-1 and N-2 contingencies.~~

Contingencies

Single Contingencies (N-1) for Power Flow Analysis:

- Colstrip – Broadview 500 kV A or B line
- Broadview – Garrison 500 kV #1 or #2 line
- Garrison – Taft 500 kV #1 or #2 line
- Taft-Bell 500 kV line
- Taft-Dworskak 500 kV line
- Taft-Hot Springs 500 kV line
- Broadview 500/230 kV bank #3
- Garrison 500/230 kV

- Loss of 1 large Colstrip unit
- Langdon-Cranbrook 500 kV outage
- Antelope - Brady 230 kV line
- Mill Creek - Antelope 230 kV line
- Mill Creek - Garrison 230 kV line
- Mill Creek - Anaconda (BPA) 230 kV line
- Mill Creek - South Butte 230 kV line
- Mill Creek - Dillon Salmon 161 kV line
- Dillon Salmon - Big Grassy 161 kV line
- Big Grassy - Jefferson 161 kV line
- Hemingway - Summer Lake 500 kV line
- Hemingway - Boardman 500 kV line
- Statewide N-1, 100 kV and above

Credible Double Contingencies (N-2) for Power Flow Analysis:

- Colstrip - Broadview 500 kV A and B lines (Category D)
- Broadview - Garrison 500 kV #1 and #2 lines
- Garrison - Taft 500 kV #1 and #2 lines
- Colstrip - Broadview -Garrison 500 kV, one circuit each segment
- Broadview - Garrison - Taft 500 kV, one circuit each segment
- Garrison - Taft - Bell 500 kV, one circuit each segment
- ~~Taft - Dworshak, Taft - Bell 500 kV~~

Performance Criteria

The power-flow simulation performance results will be measured against the North American Electric Reliability Corporation (NERC) and Western Electricity Coordinating Council (WECC) system performance criteria. Specifically, the NERC Reliability Standards TPL-001 and TPL-002 b requires transmission facilities to operate within normal and emergency limits.

~~*The viability of specific transmission projects will be evaluated using PowerWorld power flow analysis to demonstrate compliance with NERC and WECC system performance criteria as noted above, and other system specific system performance criteria noted below.*~~ *Contingency Conditions*

- Changes in bus voltages are allowed provided they remain above 0.9 p.u. and below 1.1 p.u. Changes in bus voltages from pre- to post-contingency conditions must be less than 5% for single (N-1) contingencies, and 10% for double (N-2) contingencies for neighboring regions.
- All equipment must be at or below their normal ratings under normal system conditions.

- All line, series capacitors, and transformer loadings must be at or below their emergency rating (or normal rating if no emergency rating is given), for both N-1 and N-2 contingencies.

LimitationsPerformance Violation Mitigation Method

Should a contingency cause thermal overloads, then an exploration of tripping either wind, coal or a combination of both will take place to alleviate the overload(s). It is assumed at this time that the tripping of either wind, coal or a combination of both will completely alleviate any overloads that may be observed during the study. The amount of generation tripped will be based on expected responses based on Northwestern Energy's experience with the Acceleration Trend Relay ("ATR") remedial action scheme.

For this power flow analysis, the study team will trip generation based on the expected response from the ATR given historical performance. The ATR is a computer based relay which is designed to protect the Colstrip generators and to prevent unstable events from disrupting the interconnected grid in the Western Interconnection when faults and line outages occur on the Colstrip transmission system. The ATR is calibrated to prevent the violation of the WECC dynamic voltage dip performance criterion which assures stable performance. The device monitors the real-time speed and acceleration of the four Colstrip units. It uses this information to assess the dynamic performance of the units and thus detect unstable events in progress. When a contingency occurs that could cause an unstable result, the ATR trips generators as necessary to restore the system to a stable operating condition. As stated above, this study will be done strictly with power flow and simulated ATR response, dynamics analysis will be required to verify the ATR performance for the contingencies that result in performance violations.

5. Results Reporting

In the event that tripping either wind, coal or a combination of both alleviates overloads observed on the 500 kV system during contingency, then the following steps will take place and be documented:

- Initial overloads.
- Results of tripping wind only.
- Results of tripping coal only.
- Results of tripping a combination of wind and coal.

~~For this study, NWE will trip generation based on the expected response from the ATR given historical performance. This study is power flow only; therefore, there is no opportunity to study the true response to the Acceleration Trend Relay (ATR) which is inherently a dynamic response. For this study, NWE will trip generation based on the expected response from the ATR given historical performance.~~

~~The ATR is a computer-based relay which is designed to protect the Colstrip generators and to prevent unstable events from disrupting the interconnected grid in the Western Interconnection when faults and line outages occur on the Colstrip transmission system. The ATR is calibrated to prevent the violation of the WECC dynamic voltage dip performance criterion which assures stable performance.~~

~~The device monitors the real time speed and acceleration of the four Colstrip units. It uses this information to assess the dynamic performance of the units and thus detect unstable events in progress. When a contingency occurs that could cause an unstable result, the ATR trips generators as necessary to restore the system to a stable operating condition. However, again, this study will be done strictly with power flow and not dynamics, which would be the analysis needed to investigate the reactions of the ATR for these scenarios.~~

~~In reality, should the appropriate mitigation of a contingency violation be alleviated by tripping wind, then a method must be devised to provide coordination between the tripping of the wind generators and the tripping of Colstrip units.~~

~~This analysis of the steady state power flow and the possible solutions will be written into the contingencies themselves as auxiliary files.~~

~~For any contingency that results in a loss of generation, generators in the Western Interconnection will be re-distributed according to their participation factor to account for the loss.~~