ColumbiaGrid
2017 System Assessment
Study Plan

October 7, 2016

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Introduction

The foundation for the Biennial Transmission Expansion Plan is the ColumbiaGrid System Assessment, which is an evaluation of whether or not the planned transmission grid can meet established reliability standards (primarily NERC and WECC Transmission Planning standards) and to identify Order 1000 Needs from the Order 1000 Potential Needs that were suggested to ColumbiaGrid. Any deficiencies in meeting these standards are noted in the System Assessment and then addressed either by the Planning Coordinators or Transmission Planners themselves or through ColumbiaGrid Study Teams. This document provides details on the planned process used at ColumbiaGrid to produce the 2017 System Assessment study results. In addition, it provides a summary of the approach that ColumbiaGrid will use to identify Order 1000 Needs.

Details specific to the 2017 System Assessment, such as selected cases, planned projects included in the cases, and current status, can be found in the "2017_SystemAssessment_StuyPlanDetails.xlsx" excel file available upon request.

System Assessment Timeline

Below is an approximate timeline for the System Assessment that shows details for data preparation and results processing. A detailed timeline is distributed each study cycle.

October

- Early October
  - Study Plan Meeting:
    - Select Base Planning / Stability Cases
    - Review and Update Modeling Assumptions
    - Review TPL / Stability Contingency & Automatic Action File Assumptions to be requested in January
    - Develop Base Study and Discuss Sensitivity Study Plan
- Mid October
  - Post Base Cases and Associated Transient Models for Review and Update
  - Distribute Ten Year Plan For Review

November

- Provide Case Topology, Resource, & Transient Model Updates (Due by mid November)
- Update Case Topology
- Finalize Ten Year Plan

December

- Provide Review Cases & Updated Transient Models for Members
- Solicit Order 1000 Potential Needs suggestions

January

- Early January
  - Review and **Finalize Study Cases** (Due by 16th)
- Mid January (After Case Finalization)
  - Provide TPL /Stability Contingency & Automatic Action Files

February

- Develop Contingency Lists
- Reaffirm base and sensitivity study plan
- Request updates to 2022 cases to create 2023 cases

March/April

- Process & Review Contingency Results
- Evaluate Order 1000 Potential Needs
- Process & Review Transient Stability Study Contingency Results
- Complete 2023 cases

TBD

- Prepare System Assessment
- Identify Order 1000 Needs
- Prepare Need Statement
- Approve System Assessment
- Recommend Study Teams for Proposed & Order 1000 Needs

Study Case Development

Coordinated case development has been identified by ColumbiaGrid members as a valuable process in order to provide a common starting point for members to use for their own assessments. The goal is to at a minimum provide to the members that wish to use them all of the cases required by Transmission Planning (TPL) standard TPL-001-4 and order 1000. Other cases may be produced for requested study work that cannot be accommodated by these cases. The assessment work done by ColumbiaGrid will be done on a subset of these cases.

Study Years & Base Cases

The information regarding the study scenarios required by TPL-001-4 were used to identify the study scenarios as listed in the tables below.

<table>
<tr><th rowspan="2">Study Year</th><th colspan="2">Loading Condition</th></tr>
<tr><th>Peak Load</th><th>Off-Peak Load</th></tr>
<tr><td>Year One or Year Two</td><td>X</td><td rowspan="2">X</td></tr>
<tr><td>Five Year</td><td>X</td></tr>
<tr><td>Long-Term</td><td>X</td><td></td></tr>
</table>

<table>
<tr><th rowspan="2">Study Year</th><th colspan="4">Study Scenarios</th></tr>
<tr><th>Steady State Base</th><th>Steady State Sensitivity</th><th>Short Circuit</th><th>Transient & Voltage Stability</th></tr>
<tr><td>Year One or Year Two</td><td>X</td><td>X</td><td rowspan="2">X</td><td rowspan="2">X</td></tr>
<tr><td>Five Year</td><td>X</td><td>X</td></tr>
<tr><td>Long-Term</td><td>X</td><td></td><td></td><td>X</td></tr>
</table>

TPL-001-4 requires analysis to be done on base assumption cases for year one or year two peak load, year five peak load, one to five year off-peak load, and long term peak load. To meet the case requirements ColumbiaGrid initially develops two base assumption cases for each of the peak load cases (heavy summer 2, 5, and 10 year cases and heavy winter 1, 5, and 10 year cases) and one 2 year off-peak case. These cases would be a starting point to accommodate all steady state and transient study scenarios required by TPL-001-4. Typically approved WECC cases are selected as a starting point to create these cases. The process starts in November by determining the study years for the cases and selecting base cases. Other cases may be developed based on study needs for planned sensitivities or order 1000 work.

Determining Study Years

Study years are determined based off of the projected end of the System Assessment process which is projected to be mid-summer of the Assessment year. All case study years are determined by the members.

Selecting Base Cases:

Typically the strategy used for selecting base cases is to select recently approved WECC cases that closely represent current system topology and the desired seasonal system conditions. The previous year's System Assessment cases may be selected as the new base cases if case availability is limited or it is viewed as a better starting point than the WECC cases and the previous year's cases were built from WECC cases. The topology and resources for these cases are adjusted to create the study cases. These cases will be selected by the members at the beginning of each study cycle and posted for review in mid-October.

Building Study Cases:

After base cases are selected, the study cases are developed with the intention of completing them prior to building the contingency lists.

Base Topology & Ten Year Plan:

After posting the cases members will have until mid-November to provide topology updates to the case topologies. Updates should include corrections to case errors and project adjustments to match the Ten Year Plan. The ColumbiaGrid Ten-Year Plan comprises a list of projects planning participants are committed to build in the coming years to address known transmission deficiencies. The projects in the ten-year plan fill a variety of needs such as serving load, integrating new resources, or facilitating economic transfers. To be included in the plan, the projects need to be committed projects that are typically in the permitting, design, or construction phases. The projects in the plan may have been generated in a variety of forums such as earlier System Assessments, studies completed by the study teams, or individual planning participant studies.

To maintain data quality the Ten-Year Plan will not be adjusted after it has been finalized in mid-November unless the change would invalidate the System Assessment if it is not done. Participating members would make this determination.

Loads:

Also by mid-November the members will also be asked to direct ColumbiaGrid on how to adjust loads for the System Assessment cases. The preferred options to do this are to either provide a file that updates the loads for each of the cases to the desired levels or to provide specific levels for ColumbiaGrid to scale their loads. Unless directed otherwise ColumbiaGrid would scale a participant's load by scaling only the loads designated as scalable in the base case until all of that participant's loads reach the desired level. A constant P/Q ratio would be maintained. Any expected changes to block loads for scaling should also be provided.

Resources:

All generation patterns for the System Assessment cases will initially be set to the associated seasonal WECC base case. Initial adjustments to this pattern should only be the results of corrections to better represent expected generation patterns (such as adjusting wind generation output levels) or justified changes such as a new resource or the retirement of an existing resource. Balancing of the area will be done via interchange adjustments (typically from California for winter cases and Columbia River hydro for summer cases). These adjustments are due by mid-November

Interchanges:

Interchanges are used to balance the case and stress the case. This is primarily done with the interchanges with Canada and California. The remaining interchanges are typically untouched. The California interchange is used to balance the system winter cases and Columbia River hydro for summer cases. The Canadian interchange is typically used to stress the system and is set to 2300 MW North-to-South for summer peak cases and 1500 MW South-to-North for winter peak cases to reflect current firm transmission service commitments on the Westside Northern Intertie (Path 3).

Finalizing the Study Cases:

After the loads, resources, and interchanges are adjusted the study cases will be sent out for final review. If the cases are accepted by the members they will be used to build the contingency files starting in January.

Contingencies

TPL Contingencies & Automatic Actions:

After the study cases have been finalized contingency files should be provided to comply with TPL-001-4 and WECC criterion TPL-001-WECC-CRT-2.1. A detailed description of what is needed to be submitted is described in the "ColumbiaGrid System Assessment Contingency Methodology" paper. It is suggested that a base list is created for the One-Year cases and then provide individual change files for each Ten-Year Plan project or change files for each of the 5 year and the 10 year cases. This occurs in February so processing and reviewing contingency results can occur in March and April.

Processing Contingencies

This section describes the method used to process contingency lists.

Limit Monitoring

The following limit monitoring settings are used for System Assessment contingencies:

- Seasonal normal and post contingency/emergency branch thermal limits are monitored based on WECC's convention (i.e. summer normal = limit A, summer emergency = limit B, winter normal = limit C, winter emergency = limit D, etc.)
- Radial lines and buses are not monitored.
- Only elements in Area 40 (Northwest) are monitored.

- Branch violations are only flagged if branch flow increases by more than 1%.
- Bus violations are only flagged if bus voltages change by more than 0.02 per unit.
- Bus voltage monitoring settings are supplied by participants.
- Bus voltage change of greater than 5% (based on WECC criteria).
- Voltage angle change of more than 5 degrees across branches opened in a contingency. Only angles more than 30 degrees are reported.

Post Contingency Solution Settings

The post contingency solution settings differs from the default pre solution settings by not allowing most switched shunts, LTCs, and phase shifters from operating to mimic the system conditions right after the contingency occurs. SVC devices and automatically controlled shunts are allowed to operate. Participants must provide which shunts are automatically controlled to properly model the post contingency system condition. Post contingency solution settings are used for any contingency that has a solution embedded into the contingency definition. This allows participants to document the system condition for PRC-023 for N-1-1 conditions.

Results Review Methodology:

Initially all study cases are reviewed of violations without outages (N-0 conditions). Any voltage violations or facility overloads that could not be resolved through tuning the cases are provided to the participants and reported in the System Assessment.

The provided TPL-001-4 and WECC criterion TPL-001-WECC-CRT-2.1 contingencies are then processed. All results are reviewed for accuracy and provided to participants for review. The results are pared down for additional study by the following criteria:

- N-1-X: All contingencies results with an initial outage conditions (i.e. P3 or P6) are studied for informational purposes only. Results are shared with all participants but no mitigation is suggested for these outages.
- Single System: Events where the outage facility and the overloaded facilities were owned by the same utility are assumed to be the responsibility of that utility to mitigate and are not reported in the System Assessment. The System Assessment focuses on joint issues where the outages and associated violations are owned by multiple participating utilities and joint transmission planning may be needed.

The remaining violations and any unsolved outages are further explored for validity. All violations that are confirmed to be valid violations are reported in the System Assessment.

Identify Order 1000 Needs

Order 1000 Potential Needs that were submitted to ColumbiaGrid will be evaluated the possibility to be included in the upcoming System Assessment. In this planning cycle, the process will start in January 2017 when ColumbiaGrid will send notifications requesting suggestions regarding Order 1000 Needs to be submitted to ColumbiaGrid prior to the Order 1000 Needs Meeting. Any Order 1000 Potential Needs that were received will be discussed during the Order 1000 Needs Meeting.

Following the completion of the Order 1000 Needs Meeting, the process continues with the evaluation of the Order 1000 Potential Needs to identify Order 1000 Needs that are vetted during the System Assessment process. As part of the evaluation process, ColumbiaGrid will implement applicable screening studies of the Order 1000 ColumbiaGrid Planning Region using the Order 1000 Planning criteria and Order 1000 Needs Factors to identify Order 1000 Needs from the Order 1000 Potential Needs. The results of the validation are reported in the System Assessment and Need Statement documents that will developed as part of the System Assessment.

Transient Stability Studies

In conjunction with building the study cases the WECC transient stability data will be updated to provide the ability to run transient stability studies on the developed cases. The data for the case will be reviewed and some test simulations such as no fault run, Chief Joseph Braking test, and Double Palo Verde tests will be used to verify the case(s) show satisfactory dynamic performance. Modeling data errors and potential problems will be identified and fixed. The proposed changes to the base case will be discussed in the planning meeting as basic assumptions for performing transient stability study.

With the base case ready, contingencies submitted by members will be simulated and results will be discussed with members if unexpected issues are identified. According to the discussion in transient stability workshop, unstable contingencies, WECC transient limit violations, and generation tripping will be reported in the System Assessment.

Other Studies

Other studies may be included in the System Assessment report from sensitivities requested by ColumbiaGrid members to be part of the study process or from work done outside the process. The scope of these studies is determined by the members and typically address identified issues in the system, studies associated with new planning standards, or possible future issues caused by policy changes.