



**Transmission Services
Transmission Planning**

2018 Transmission System Assessment Assumptions and Methodology

March 2018

Executive Summary

One of the primary objectives outlined under FERC Order 890, Attachment K is the development of a transmission expansion plan that covers a ten-year planning horizon. This plan identifies projected transmission reinforcements based on forecasted load growth, projected firm transmission service commitments, interconnection requests, and system reliability assessments. The objective of the assessment is to test the reliability of the transmission system under a variety of system conditions.

System Reliability Assessments may be based on current or qualified past studies as allowed by the NERC TPL-001-4 Reliability Standard. This document describes the Assumptions and Methodology used for the 2018 System Assessment.

Introduction

One of the primary objectives outlined under FERC Order 890 Attachment K is the development of a Transmission Plan that meets the Transmission Provider's reliability, safety, economic and environmental objectives in the most cost-effective manner. The primary objective of the transmission plan is to identify projected long-term transmission needs and system reinforcements on the Transmission Provider's system to meet the NERC TPL-001-4 Reliability Standard.

The process to develop the Transmission Plan includes the following:

- Perform an annual assessment of BPA's transmission system performance for the near term (both 1-2 and 2-5 years out) and long term (6-10 years out) timeframes.
- Develop system reinforcement plans expected to allow BPA's Transmission System to meet applicable Planning Criteria and Standards throughout BPA's 10 year planning horizon.
- Address reliability needs as well as interconnection and transmission service requests on the Transmission Provider's system.
- Consider plans and proposed projects developed by neighboring systems, and sub-regional and regional planning processes.
- Develop plans of service from a one-utility perspective that meet economic, environmental, public policy obligations, and other objectives of the system.

Attachment K requires that BPA, in coordination with Stakeholders and other Interested Persons, shall perform a System Assessment. The objective of this assessment is to determine the ability of the BPA system to serve its network load obligations, and other committed long-term transmission obligations that are anticipated to occur during the planning horizon. This document describes the Assumptions and Methodology used for the 2018 System Assessment.

Planning Assumptions

The major assumptions that form the basis of the System Assessment study are load forecasts, generation, and existing transmission facilities as well as planned future transmission upgrades and additions. System Reliability Assessments may be based on current or qualified past studies as allowed by the NERC TPL-001-4 Reliability Standard.

For all studies that support the assessment, BPA starts with approved base cases developed by the Western Electricity Coordinating Council (WECC). These cases are selected to represent the near-term (both 1-2 and 2-5 years out) and long-term (6-10 years out) planning horizons. BPA updates these cases as necessary and establishes the system patterns to study, including generation dispatch and loading on interties and flow gates.

The 2018 System Assessment is based primarily on qualified past studies from 2017. The base cases for those studies originated from WECC approved base cases representing the following years and seasons:

Base Cases

- 2019 Summer peak load conditions (near term 1 to 2 years out);
- 2019 Winter peak load conditions (near term 1 to 2 years out);
- 2019 Spring off-peak load conditions (near term 1 to 2 years out);
- 2022 Summer peak load conditions (near term 2 to 5 years out);
- 2022 Winter peak load conditions (near term 2 to 5 years out);
- 2027 Summer peak load conditions (long term 6 to 10 years out);
- 2027 Winter peak load conditions (long term 6 to 10 years out)

BPA updates these base cases with the latest network topology, potential future resources as appropriate, and seasonal load forecasts.

Validation

NERC TPL-001-4 requirement R2.6 allows qualified past studies to be used to support the current compliance assessment if the past studies are 5 years old or less and no “material changes” have occurred to the system since the past study. Studies older than 5 years may be used if a technical rationale can be provided to demonstrate that the results of an older study are still valid.

BPA’s 2018 system assessment is based primarily on qualified past studies from 2017. To ensure the 2017 studies are still valid for 2018, several factors were considered, including:

Load forecast – The load forecast assumed in the past study is compared with the latest forecast for each load area. If there is no significant change between them, then the past study is still valid in terms of the load forecast.

Historical Peak Loads – Historical data for summer and winter peak loads is analyzed to see if loads in the area reached any new peaks since the past study was completed. If there were no new peak loads recorded, then the past study is still valid in terms of the peak area load.

Topology – The network topology (transmission and generation) that was modeled in the past studies is compared with the latest network topology information. If there have been no major topology changes since the past studies were completed, then the past study is still valid in terms of network topology.

Applying these factors ensured that the studies from 2017 were qualified past studies to use as the basis for the 2018 system assessment.

Planning Criteria

BPA plans the transmission system to meet the performance criteria contained in the NERC Reliability Standard (TPL-001-4) and the WECC Reliability Criteria (TPL-001-WECC-CRT-3.1). These require that the transmission system is planned to supply projected customer demands and projected firm transmission services over the range of forecast system demands. System performance has to meet the standards under a wide variety of conditions including the loss of single or multiple transmission elements such as transmission lines, transformers, and generators. Under these conditions the system must remain stable; both thermal and voltage levels must be within applicable ratings.

Load Modeling

The transmission system is planned to meet the performance criteria contained in the NERC TPL Reliability Standard over the range of forecast demand levels. To comply with these requirements, BPA utilizes peak load forecasts over a 10-year horizon. Any material changes to the load forecast information for both winter and summer seasons is identified annually with customer input, and incorporated into the model.

Resource Modeling

For the studies, existing generating resources or resources with firm transmission contracts for the near term (both 1-2 and 2-5 years) planning horizon are modeled. The existing resources with firm transmission contracts in the region are adequate to meet peak load and firm export requirements over the five-year time frame. In the long term horizon (6 to 10 years), if the Northwest's internal resources (with firm transmission contracts) are not sufficient to meet peak winter peak load levels, then the Northwest can leverage seasonal diversity in regional peak loads to make up the difference with intertie imports. In the base cases representing the longer-term (6 to 10 year) planning horizon, some proposed future resources may be modeled to meet the forecasted loads.

With several thousand megawatts of installed wind generation capacity in the Northwest, this type of intermittent resource can have a significant effect on transmission system performance. As a baseline the system is evaluated with zero output from wind generation since loads must be served regardless of wind output. The studies also include the impact of higher wind generation output where appropriate for the affected areas.

Firm Transmission Service

As required by the NERC TPL Reliability Standard it is necessary to evaluate the system's capability to accommodate firm transmission service commitments. NERC Standards require that plans are developed to address existing long-term firm transmission service commitments during the planning horizon. The NERC TPL Reliability Standard requires that there is no loss of load or curtailment of firm transfers for normal system conditions or single element (N-1) outages, with the exception of up to 75 MW subject to a stakeholder process. The NERC TPL Reliability Standard allows planned and controlled loss of demand or curtailment of firm transfers for multiple element outages.

Remedial Action Schemes

Remedial Action Schemes (RAS) are a set of fast, automatic, event-based control actions used to ensure acceptable power system performance. For the studies, existing RAS is modeled when appropriate based on the system conditions modeled.

Future Projects

Since adding conceptual projects could mask future system problems, which are the focus of the System Assessment, conceptual projects are typically not included in the base cases. The only future projects included in the studies are those where the sponsoring utilities have made firm commitments to build the project within the ten year Planning horizon. These are typically projects that are currently under construction or that have project and funding approval and are currently included in scheduled work plans. By including only projects that are actively being pursued, the next level of potential transmission reinforcements can be identified.

Transmission Facility Ratings

BPA transmission facility ratings included in this study are based on the most recent information available. Ratings for neighboring utility facilities are provided by the owner of the facility. For these facilities seasonal ratings are applied whenever such information is available.

Sensitivity Cases

From the initial set of WECC-approved base cases, additional base cases are also developed as sensitivities to represent other “stressed” patterns or system conditions. These sensitivities may vary one or more of the following conditions:

- Load level, load forecast, or dynamic model assumptions;
- Expected transfers;
- Expected in service dates of new or modified Transmission Facilities;
- Reactive resource capability;
- Generation additions, retirements, or other dispatch scenarios;
- Other system conditions unique to specific geographical areas.

Planning Methodology

System Assessment

The annual System Assessment will use current or qualified past studies as required by NERC TPL-001-4. Once the base cases are established for these studies, the system with all facilities in service (no outage condition) is examined to assess whether the NERC TPL-001-04 Planning Reliability Standard is met. Potentially deficient areas are noted for follow-up and possible corrective action plans.

Next a comprehensive contingency analysis examines all credible single element (N-1) outages of transmission facilities for each of the base cases. Outages that result in facility loadings exceeding their thermal ratings or voltages outside of accepted guidelines are identified and individually reviewed to determine if additional studies or corrective action plans are required. In addition to the single contingency analysis, selected credible multiple element contingencies, are studied. The Assessment includes simulations of breaker failures, bus faults, and the loss of lines on common towers (double circuit lines), as well as extreme events, such as loss of entire substation(s) and applicable common corridor outages.

The System Assessment includes evaluations of steady state, voltage stability, transient stability, and short circuit performance for compliance with the NERC TPL Reliability Standard and WECC Reliability Criteria. For the steady state performance, equipment loadings are required to be within their applicable ratings and voltages within accepted guidelines. For voltage stability performance, the system is evaluated for adequate margin as appropriate. For transient stability performance, any system oscillations must be stable and damped and should meet the voltage and frequency criteria. Short circuit studies are performed for the near term planning horizon, by simulating single phase and three phase faults throughout BPA’s network and monitoring the resulting fault current at substations. The fault current is compared with the ratings of the circuit breakers at the substations to determine whether the breakers have adequate interrupting capability for faults they will be expected to interrupt. If the resulting short circuit current interrupting duty on any circuit breakers exceeds their rating, then a corrective action plan is developed. Typically, BPA will replace the under-rated breaker with one that has a higher short circuit rating. BPA has an annual switchgear replacement program that incorporates these circuit breaker replacements.

The results of the System Assessment with supporting studies are used to compile a list of areas with potential system deficiencies for further verification and development of conceptual solutions. When completed, the availability of a summary of the System Assessment results will be posted to the BPA Attachment K web page.

Develop Alternative Conceptual Solutions

For those areas where the System Assessment indicated potential deficiencies in performance, alternative solutions are explored to correct the problems. These conceptual plans may include transmission expansion projects, facility upgrades, and/or non-wires solutions such as energy efficiency, distributed generation, redispatch, or demand side management.

Cost Estimates for Alternative Solutions

Preliminary cost estimates are developed for the alternative conceptual solutions. These preliminary estimates, in addition to technical performance, are used to compare alternatives in order to determine the most efficient and cost-effective plan of service.

Develop Plan of Service for Preferred Alternative

The next step is developing a final plan of service selected from among the viable alternatives. This development follows a process that includes: establishing a project team and drafting a Project Requirements Diagram (PRD). Then, a Concept Design Document (CDD) is drafted with input from several workgroups and project scoping begins. When scoping is completed, the plan of service is finalized along with the PRD. Cost estimates are updated based on the final plan of service. This is followed by developing a business case and requesting capital funding approval for the project. Those projects most likely to be pursued for funding are documented in the BPA Transmission Plan, which is updated annually at the end of each calendar year and posted on the BPA Attachment K webpage at the completion of the planning cycle.