

B O N N E V I L L E
P O W E R A D M I N I S T R A T I O N



Transmission Services
Transmission Planning

2025 Transmission System Assessment Assumptions and Methodology

April 2025

Executive Summary

Attachment K is a FERC requirement for sharing information about the planning process and developing a transmission expansion plan that covers a 10-year planning horizon. This plan identifies projected transmission reinforcements based on forecasted load growth, projected firm transmission service commitments, interconnection requests, and BPA's annual System Assessment. The System Assessment examines the performance of the transmission system under a variety of system conditions and compliance with NERC's TPL-001-5.1 Reliability Standard.

This document describes the assumptions and methodology used for the current 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 goal 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-001-5.1 Reliability Standard.

The process to develop the Transmission Plan includes the following:

- Perform an annual assessment of BPA's transmission system performance for Near Term (1-2 and 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 reliability assessment (System Assessment). The System Assessment determines the ability of the BPA system to serve its network load obligations and other committed long-term transmission obligations within the planning horizon. This document describes the assumptions and methodology used for the current 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. The NERC Standard TPL-001-5.1 permits the use of current or qualified past studies for the System Assessment.

BPA utilizes approved base cases developed by the Western Electricity Coordinating Council (WECC) to represent the Near Term and Long Term planning horizons for the System Assessment. BPA updates these cases as necessary and establishes the system patterns to study, including generation dispatch and loading on interties and flow gates.

The 2025 System Assessment primarily based on the results of new studies. The base cases originated from WECC approved base cases modified to represent the following years and seasons:

Base Cases

- 2026 Summer peak load conditions (Near Term)
- 2026 Winter peak load conditions (Near Term)
- 2026 Spring off-peak load conditions (Near Term)
- 2030 Summer peak load conditions (Near Term)
- 2030 Winter peak load conditions (Near Term)
- 2034 Summer peak load conditions (Long Term)
- 2034 Winter peak load conditions (Long Term)

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

Validation

The NERC Standard TPL-001-5.1 requirement R2.6 allows qualified past studies to be used to support the current System 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.

The 2025 System Assessment is based primarily on the results of new studies.

Planning Criteria

The BPA transmission system is planned to meet applicable NERC System Performance Standards (TPL-001-5.1) and the WECC System Performance Regional Criteria (TPL-001-WECC-CRT-4). These require that the transmission system be planned to supply projected customer demands and firm transmission services over the range of forecasted 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. The system must remain stable and both thermal and voltage levels must be within applicable ratings under these conditions.

Load Modeling

The transmission system is planned to meet a range of forecast demand levels. BPA utilizes peak load forecasts over a 10-year horizon. Any material changes to the load forecast information for both winter and summer seasons are identified annually with customer input and incorporated into the model.

Resource Modeling

Existing generating resources or resources with firm transmission contracts for the Near Term planning horizon (both 1-2 and 5 years) are modeled in the studies. The existing resources with firm transmission contracts in the region are adequate to meet peak load and firm export requirements in the Near Term. In the Long Term, if the internal resources (with firm transmission contracts) in the Pacific Northwest system are not sufficient to meet winter peak load levels, diversity in regional peak loads can be leveraged to make up the difference with intertie imports. In the base cases representing the Long Term planning horizon, some proposed future resources may be modeled to meet the forecasted loads.

With several thousand megawatts of installed capacity in the Northwest, wind generation can have a significant effect on transmission system performance. Baseline studies assume zero output from wind generation as loads must be served

regardless of wind generation output. The studies also include the impact of higher wind generation output where appropriate for the affected areas.

Firm Transmission Service

The NERC TPL-001-5.1 Reliability Standard requires the System model to include known commitments for firm transmission service. There should be no loss of non-consequential load or interruption of firm transfers for normal system conditions or single element outages, with the exception of up to 75 MW of non-consequential load loss subject to a stakeholder process. Planned and controlled loss of demand or curtailment of firm transfers is allowed for multiple element outages.

Remedial Action Schemes

A Remedial Action Scheme (RAS) is 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

Conceptual projects that may mask existing system issues 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 planning horizon. Typically, these projects are currently under construction or have funding approval and are included in scheduled work plans. By including only these committed projects, the next level of potential transmission reinforcements can be identified.

Transmission Facility Ratings

BPA transmission facility ratings included in the system assessment are based on the most recent information available. Ratings for neighboring utility facilities are provided by the owner of the facility. 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 uses current or qualified past studies as required by the NERC Reliability Standard. The system with all facilities in service is evaluated to determine whether performance meets the NERC TPL-001-5.1 Reliability Standard. Potentially deficient areas are noted for follow-up and possible corrective action plans.

Next, a comprehensive contingency analysis examines all credible single element 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 reviewed to determine the necessity of additional studies or corrective action plans. In addition to the single element outages, selected credible multiple element contingencies are studied. The System Assessment includes simulations of breaker failures, bus faults, 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-001-5.1 Reliability Standard, WECC Reliability Criteria and BPA's Reliability Criteria for System Planning STD-N-000001. 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 reactive power margin. For transient stability performance, system oscillations must be stable and damped and should meet the voltage dip and voltage recovery performance requirements.

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. If the calculated short circuit current exceeds the rating of a breaker, a corrective action plan is developed. Typically, BPA will replace the underrated breaker with one possessing a higher short circuit rating. BPA has an annual switchgear replacement program that incorporates these circuit breaker replacements driven by fault duties.

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

Develop Conceptual Solutions

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

Cost Estimates for Conceptual Solutions

Preliminary cost estimates are developed for the conceptual solutions. These preliminary estimates, in addition to technical performance, are considered when determining the most efficient and cost-effective plan of service.

Develop Plan of Service for Preferred Solution

Plans of service are developed for the viable conceptual solutions. This development follows a process that includes:

1. Establishing a project team and drafting a preliminary Project Requirements Diagram (PRD).
2. Drafting a Concept Design Document (CDD) with input from several workgroups during project scoping.
3. Finalizing the plan of service and PRD and updating the cost estimates.
4. Developing a business case and requesting capital-funding approval for the project.

Projects which are most likely to be funded and pursued 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.