# Regional Transmission Plan for the 2022-2023 NorthernGrid Planning Cycle

*NorthernGrid Member Planning Committee (MPC)*
*Approval Date: December 14, 2023*

# Acknowledgements:

**NorthernGrid Members**
Avista Corporation
BHE U.S. Transmission (MATL)
Bonneville Power Administration
Chelan County PUD
Idaho Power Company
NorthWestern Energy
NV Energy
PacifiCorp
Portland General Electric
Puget Sound Energy
Seattle City Light
Snohomish County PUD
Tacoma Power
**Interregional or non-Incumbent Transmission Project Sponsors**
PowerBridge – Cascade Renewable Transmission Project
Absaroka Energy, LLC – Loco Falls Greenline
TransCanyon, LLC – Cross-Tie Transmission Line
Great Basin Transmission, LLC – Southwest Intertie Project – North
**Neighboring Regional Entities**
CAISO
WestConnect
**Participating State Agencies**
Idaho PUC
Idaho OER
Montana PSC
Montana Consumer Counsel
Oregon PUC
Utah Department of Commerce
Utah Office of Energy Development
Washington UTC
Washington EFSEC
Wyoming PSC
**Consultants and Other Contributors**
Western Power Pool
Power Systems Consulting (PSC)
Western Electricity Coordinating Council – power flow and production cost model base cases

Copies of this report are available from:
Western Power Pool
7525 NE Ambassador Place, Suite M, Portland, OR 97220
nwpp_northerngrid_staff@westernpowerpool.org or
WPP_RTPS_Staff@westernpowerpool.org
(503) 445-1074

# Executive Summary

The NorthernGrid is an unincorporated association of entities that either own or operate, or that propose to own or operate, electric transmission facilities in the Western Interconnection. The NorthernGrid promotes coordinated, open, and transparent transmission planning and facilitates compliance with Federal Energy Regulatory Commission ("FERC") Orders No. 890 and 1000. The NorthernGrid is comprised of entities regulated by FERC and those that are not. The regional transmission planning process for the enrolled FERC jurisdictional Transmission Providers is defined in each provider's Open Access Transmission Tariff Attachment K – Regional Planning Process. The NorthernGrid entities that are not regulated by FERC participate in the regional transmission planning process through the NorthernGrid Planning Agreement for Planning Cycle 2022-2023.

The NorthernGrid 2022-2023 Regional Transmission Plan was developed according to the NorthernGrid regional planning process. The load and resource assumptions, transmission power flow conditions, analysis methods, and criteria used are described in the 2022-2023 Study Scope. A link to the Study Scope is provided in Appendix B: Study Scope. The objective of the planning process is to identify the projects that either cost-effectively or efficiently meet the needs of the NorthernGrid region in a 10-year horizon.

The process began in the first quarter with each NorthernGrid Member submitting their 10-year forecasted load, projected resource additions, retirements, public policy requirements, and projected transmission additions. During this quarter, non-member entities were also permitted to submit regional transmission projects for consideration. Four non-incumbent transmission project developers, Absaroka Energy LLC, TransCanyon LLC, Great Basin Transmission LLC, and PowerBridge LLC, submitted transmission projects. Three of these developers also submitted information that met the Qualified Developer criteria for the purpose of project cost allocation. All this information was summarized and incorporated into a Study Scope. The Study Scope also describes the process, assumptions, power flow case selection, production cost modeling use, analysis methods, and criteria.

The Members chose several Western Electricity Coordinating Council (WECC) 2032 and 2033 power flow base cases representing heavy summer, heavy winter, and light spring conditions for reliability analysis. These cases were modified to achieve the following three transmission stress conditions:

- 2032 heavy summer loads with high power flow as follows: from Oregon to California, from Washington and Oregon to Idaho, and Alberta to Montana,
- 2031-2032 heavy winter loads with typical seasonal generation resource dispatch and power flow from Montana to Alberta, and
- 2033 light spring loads with high power flows from California to Oregon.

An additional heavy winter power flow case was developed through analysis of the 2032 Anchor Data Set production cost model (PCM) to analyze westbound transmission flows from Wyoming wind resources across the Northern Grid region. The hour with the heaviest westbound flows out of Wyoming was selected to represent regional transmission stress conditions during high Wyoming wind generation. This hour occurred at noon on December 11, 2032, in the PCM model.

Each power flow case's regional transmission configuration was modified to represent 28 unique regional combinations of the submitted regional transmission projects. The combinations ranged from including no to all submitted regional transmission projects. Then, contingency analysis was performed on these power flow cases using 230 kV and above electrical facility contingencies submitted by the Members. Facilities within the NorthernGrid region and adjacent regions were monitored for reliability criteria violations.

The regional combinations were ranked based on the weighted number of reliability criteria violations occurring during the contingency analysis. The regional combination with the fewest violations received the highest ranking. The 2023 Regional Transmission Plan was selected based on the regional combination ranking and total estimated cost of the projects included in the regional combination.

The regional combination of Boardman to Hemingway, Gateway West Phase 1, and Cascade Renewable Transmission Project received the highest contingency analysis ranking. A review of the violations identified that the eliminated violations changed from slightly above to slightly below the criteria threshold. When considering this minimal improvement and the additional project cost, the combination including Cascade Renewable Transmission Project was deemed less cost effective than the regional combination of Boardman to Hemingway and Gateway West Phase 1. A cost allocation analysis was not required because no Qualified Developers' projects were selected into the Regional Transmission Plan. Figure 1 below depicts the projects evaluated and those, with pink highlight, that were determined to be the most efficient and cost-effective combination for the NorthernGrid region given the analysis performed as described in this report.

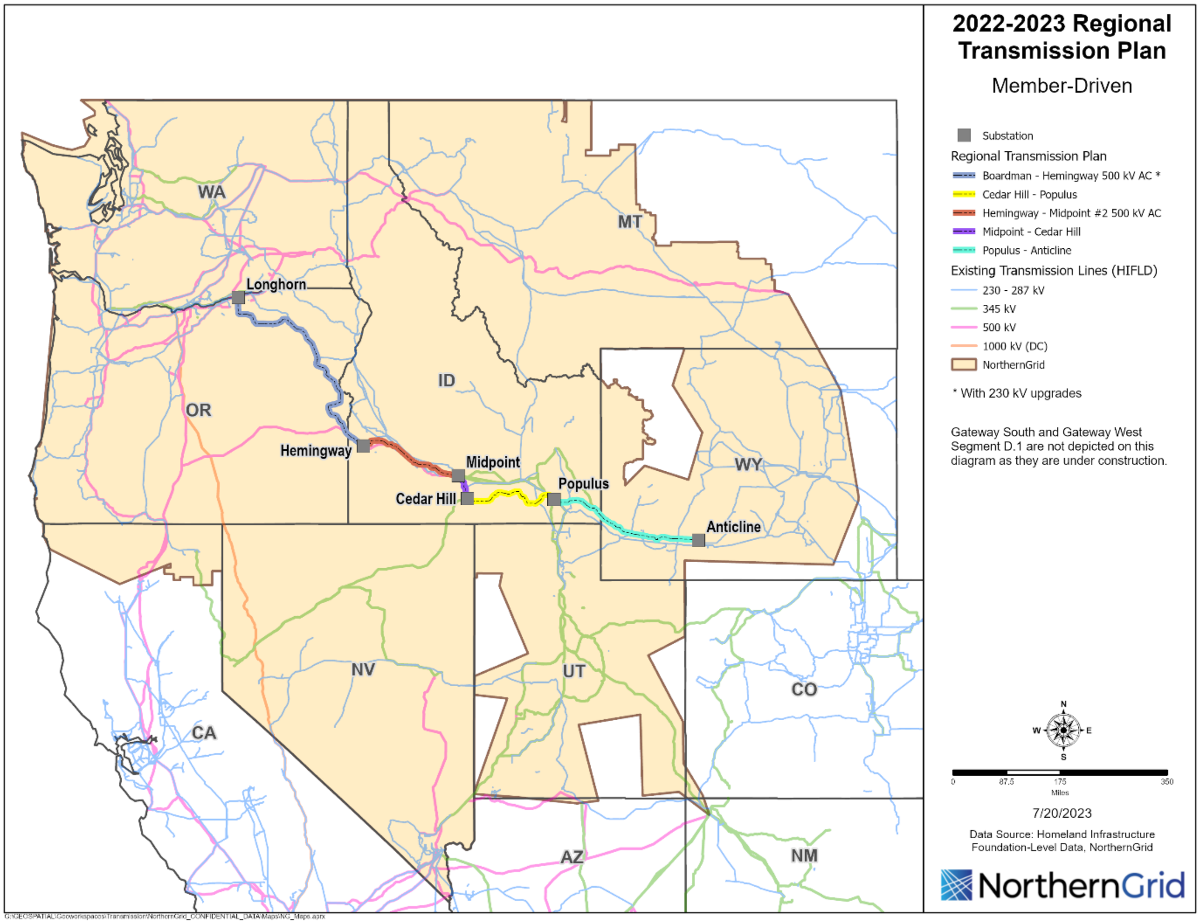


*Figure 1: Regional Transmission Plan, regional combination 11*

# Table of Contents

## Contents

# Regional Transmission Plan Development

## Transmission Planning Requirements

The Federal Energy Regulatory Commission ("FERC") requires, through orders 890 and 1000, each Transmission Provider ("TP") to publish local and regional transmission plans on a periodic basis using open and transparent processes. FERC requires that each Transmission Provider develop and file their transmission planning processes for FERC's acceptance. Once accepted, the processes are published in the provider's Open Access Transmission Tariff Attachment K – Transmission Planning Process.

Additionally, FERC requires all TPs to participate in transmission planning regions to develop these regional transmission plans. For the NorthernGrid, TPs who meet certain requirements may enroll in the region to become an Enrolled Party. The regional transmission planning process for the Enrolled Parties is defined in each Enrolled Party's Open Access Transmission Tariff Attachment K.

Federal, municipality, and public utility district electric utilities are not subject to FERC regulation, but also perform local and regional transmission planning to meet their load, resource, and transmission requirements. These entities voluntarily participate in regional transmission planning with the TPs through the NorthernGrid Planning Agreement for Planning Cycle 2022-2023.

## NorthernGrid Overview

The NorthernGrid regional planning association is composed of Avista (AVA), Bonneville Power Administration (BPA), Chelan PUD (CHPD), Idaho Power Company (IPC), BHE U.S. Transmission as the owner of the Montana Alberta Tie Line (MATL), NorthWestern Energy (NWMT), NV Energy (NVE), PacifiCorp East and West (PACE and PACW), Portland General Electric (PGE), Puget Sound Energy (PSE), Seattle City Light (SCL), Snohomish PUD (SNPD), and Tacoma Power (TPWR). The Member Balancing Authority Areas and SNPD load service footprint are illustrated in Figure 2 below.

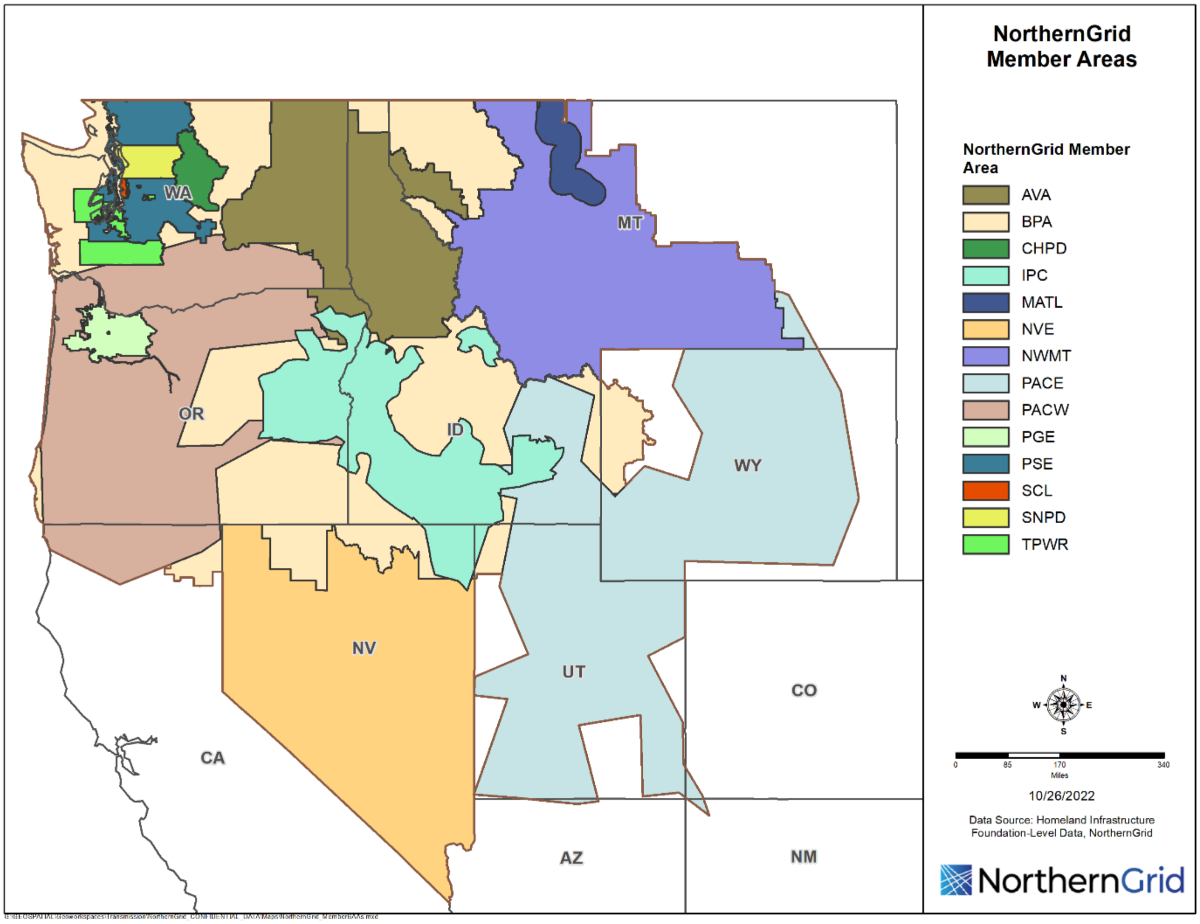


*Figure 2: NorthernGrid region*

## Planning Development

The intent of FERC Order No. 1000 is to improve the regional planning process and identify opportunities for any transmission developer, incumbent or non-incumbent, to coordinate and develop solutions that are both beneficial to the developer as well as the regional system to which that developer interconnects. Given proper coordination and communication, only the necessary facilities would get identified, and those facilities would become the Regional Transmission Plan ("RTP"). The RTP is not a construction plan, and the Members have no obligation to build the facilities identified in the RTP.

There are many factors that get considered in a long-term planning process. Utilities are charged with maintaining the reliability of the transmission system as well as ensuring there are sufficient resources and/or transmission service arrangements to serve their respective loads. FERC No. 890 and No. 1000 mandate long-term, coordinated planning at both the local and regional levels. North American Electric Reliability Corporation (NERC) planning standards TPL-001-4 and 5.1 provide criteria for performing contingency analysis on facilities 100 kV and above and is used in the FERC planning process.

Integrated resource planning is a complex process that each utility undertakes to identify and meet its respective generation portfolio needs. Resource planning may contemplate market-driven transmission sales, public policy requirements and/or considerations, environmental impacts, corporate business goals, resource adequacy, load growth and/or any other slew of topics that consider or influence the relationship between the consumer and the utility.

The timelines for resource and reliability planning are not one and the same; each follows its own cycle according to its respective requirements. The timeline for reliability planning is prescribed, cyclical, and regular: in January of every even-numbered year, a twenty-four-month cycle is initiated for the purposes of producing a regional transmission plan by the end of December in every odd-numbered year. This twenty-four-month cycle is listed in the open access transmission tariffs of all the FERC-jurisdictional utilities and is specified in the NorthernGrid Planning agreement for those non-FERC-jurisdictional utilities that are Members of the NorthernGrid planning process.

The cycle for resource planning is not necessarily "universal" in that all utilities adhere to the same schedule; the timelines for resource planning are not as prescribed or regular and may be dependent on external factors such as changes to public policy. Resource planning cycles that initiate at or near the beginning of a transmission planning cycle or make a shift during the two-year transmission planning cycle may not necessarily get reflected in the current transmission planning cycle. Once a new resource need is identified, utilities not only need to identify the public policy-driven resource need for their system, they often also have to start an open and transparent bidding process to notify all of their need for resources. There are many mechanisms that drive the need for resource procurement; a change to public policy requirements is a simple example that illustrates the inherent complexity in any given resource procurement process.

There is a relationship between resource planning and reliability planning. Once the results of the resource bid are known, the reliability analysis needed to incorporate the results of the resource bid can begin. Transmission models can then be updated to analyze the impacts of the resources identified in the resource procurement process.

The resource procurement process involves many intricacies. From the identification of the resource through to the identification of the transmission facilities needed to support the output of the selected resource, there is the possibility that resources that are identified in a resource procurement process are not necessarily yet reflected in the current regional planning study.

Annually, the Member utilities each compile their collective needs into the form of a Loads and Resources data submittal which gets submitted to Western Electric Coordinating Council (WECC) as part of WECC's base case building process. NorthernGrid uses those WECC base cases in the planning process.

## Interregional Coordination

NorthernGrid met with WestConnect and CAISO to coordinate power flow cases, assumptions, and methodologies at the Annual Interregional Information Exchange. No interregional projects were submitted for consideration into the NorthernGrid region in the 2022-2023 cycle. Representatives from the regions met on a near-monthly basis with some of them being on-site to discuss study efforts, inform one another on any new developments, and identify opportunities for stakeholder engagement.

### State Agency Engagement

Several state agencies participated in the planning process through the Enrolled Parties and States Committee (EPSC). The EPSC reviewed and actively participated in the development of the study scope.

### Stakeholder Engagement

Stakeholders are invited to participate in the public meetings and comment periods. They will also have active involvement in the development of the regional transmission plan. The first period for stakeholder comments begins with the publishing of the Draft Study Scope. There are three main opportunities to provide comment, and they are in response to the following publications: the proposed Study Scope, the Draft Regional Transmission Plan, and the Draft Final Transmission Plan. Members of the public are invited to Subscribe to NorthernGrid activities through the subscription feature on the northerngrid.net website.

## Study Process

The Regional Transmission Plan ("RTP") is the result of the work performed as outlined in the study scope for the NorthernGrid 2022-2023 regional transmission planning process.

The regional planning process is a "bottom up" approach that begins with a compilation of the Members' loads, generation resources, local area plans, and regional transmission projects. The Members who are Transmission Providers, in conjunction with participation from stakeholders, public service commissions, and interested parties, have developed local area plans that meet the regulatory requirements for their respective areas. The projects that have been identified in the local area planning process are assumed to be in service for the regional planning effort.

To develop the Plan, the NorthernGrid members ("Members") established the Baseline Projects which were then evaluated for inclusion in the final Regional Transmission Plan. NorthernGrid used power flow contingency analysis to assess which projects could best meet system reliability performance requirements and transmission needs for the NorthernGrid region in a 10-year future. Members submitted updated Load and Resource information which was incorporated into the study effort.

This regional planning process is intended to focus on those projects that are of "regional significance". "Regional significance" is not a defined term; rather, it is used to describe those projects whose presence, or lack thereof, would influence the overall reliability of the NorthernGrid region. A local project may improve the ability to serve native load or decrease the number of unplanned outages for a specified subsystem, but typically is not going to influence larger transmission paths. However, it is possible that a project that is more regional in nature may both increase the ability to serve native load as well as influence a larger transmission path.

The production of a Regional Transmission Plan satisfies FERC Order 1000 requirements for each region to produce a plan.

## Study Scope

The objective of the transmission planning study is to produce the NorthernGrid Regional Transmission Plan, through the evaluation and selection of regional and interregional projects that effectively satisfies all the transmission needs within the NorthernGrid region. The regional needs were sourced from member data submissions, including load forecasts, generation resource additions and retirements, projected transmission additions, and public policy requirements. The study scope identifies different power flow conditions and different regional transmission project combinations to assess and develop the RTP. A link to the Study Scope is provided in Appendix B: Study Scope.

## Study Methodology and Criteria

To assess the 2032 loads, resources, and transmission projects anticipated for the NorthernGrid region, a combination of power flow and production cost model techniques were used.

A WECC base case was then put through a production cost modeling effort to identify stressed conditions on the NorthernGrid region based on the economic dispatch of planned resources. The stressed conditions were translated into base cases which became the basis for the analysis effort. The selected base cases were run through a contingency analysis using member-supplied contingencies. All contingencies were categorized per the NERC transmission planning criteria document, “TPL-001-4”. The NorthernGrid region as well as immediate neighboring regions were monitored. The analysis of the contingency results accounted for any area-specific member utility criteria, otherwise, the Western Electric Coordinating Council’s (WECC) and NERC TPL-001-4 criteria was used.

## Submitted Loads and Resources

Members submitted Loads and Resources data along with their current transmission plans in the first quarter; this data was consolidated and used to develop the Study Scope. The needs of the NorthernGrid region were identified through these submittals. The NorthernGrid region load is forecast to grow at a 0.6 percent annual rate with the Members needing 29,274 MW of new generation capacity to replace the 8,236 MW planned resource retirements. Additionally, Puget Sound Energy submitted updated resource data in the fifth quarter which increased the new generation. All loads and resources characteristics are captured in the Study Scope which is available in Appendix B: Study Scope.

## Submitted Projects

The following projects were submitted by the Members and are identified as having the potential to impact the reliability of the NorthernGrid region.

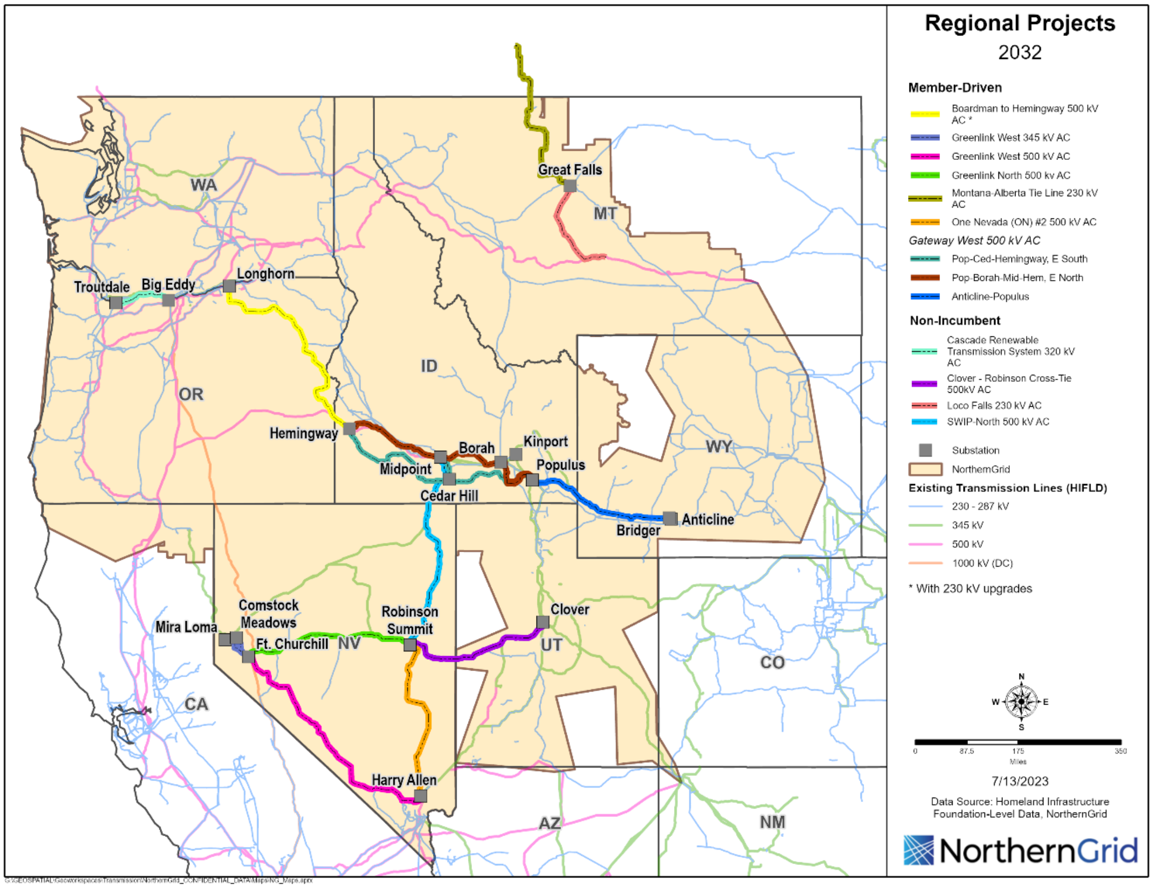


*Figure 3: NorthernGrid region with regional project overlay. Proposed 345 kV and 500 kV facilities are displayed.*

Figure 3 provides a visual demonstration of the projects that have been submitted for consideration in the Regional Transmission Plan. The legend delineates the member and non-incumbent submitted projects.

## Member Regional Transmission Projects

The regional projects submitted by Members are as follows:

**Longhorn to Hemingway (Formerly known as Boardman to Hemingway and referenced as B2H)**

Longhorn to Hemingway 500 kV, Hemingway to Bowmont 230 kV, and Bowmont to Hubbard 230 kV. Includes three sections of series compensation. The Oregon end of the line was terminated at the Longhorn station, which is near the town of Boardman, Oregon. While the figures do not visually display the 230 kV facilities associated with the B2H project, the 230 kV facilities are included in the model for B2H as they are needed to integrate B2H into Idaho Power's system. The B2H project was selected into the 2020-2021 NorthernGrid Regional Transmission Plan.

**Gateway West-** A suite of project segments were evaluated for Gateway West. These are:

Populus-Cedar Hill-Hemingway 500 kV

Populus-Borah-Midpoint-Hemingway 500 kV
Midpoint-Cedar Hill 500 kV
Anticline-Populus 500 kV

Of the Gateway West projects, only the Populus-Cedar Hill-Hemingway and Anticline-Populus 500 kV lines were selected into the 2020-2021 NorthernGrid Regional Transmission Plan. The Gateway West projects were grouped per Table 4 in the Study Plan

**Greenlink West and North**

West: Northwest – Harry Allen 500kV, Harry Allen – Fort Churchill 500 kV with series compensation, Fort Churchill – Comstock Meadows 345 kV & Fort Churchill – Miraloma 345kV. Also includes upgrades to the 345 kV system.

North: Fort Churchill –Robinson Summit 500 kV with series compensation.

**One Nevada #2-** 500 kV #2 from Harry Allen to Robinson Summit. This 235-mile line project provides a second parallel path from the NV Energy South system into Robinson Summit, effectively strengthening the existing ON line 500kV.

**MATL-** MATL proposed a conversion of the MATL alternating current (AC) to direct current (DC). The rating will increase to a maximum of 500 MW. MATL was not selected into the 2020-2021 Regional Transmission Plan.

## Non-Incumbent Transmission Projects

The NorthernGrid regional planning process allows non-incumbent and merchant transmission developers to submit projects for analysis. Several non-incumbent or merchant transmission projects were received during the submission period. They are further classified into regional and interregional transmission projects based on whether the project terminals are within the region or interconnect between regions, i.e. interregional. For the 2022-2023 planning cycle, none of the submitted non-incumbent projects were deemed interregional.

**Cascade Renewable Transmission Project-** PowerBridge LLC is proposing to construct the Cascade Renewable Transmission Project. This Project is an 80-mile, 1,100 MW transfer capacity +/- 400 kV HVDC underground cable (95 percent installed underwater) interconnecting with the AC grid through two +/- 1100 MW AC/DC converter stations at Big Eddy and Harborton substations. There are no proposed generation resources associated with the transmission line.

**Loco Falls Greenline-** Absaroka Energy LLC is proposing a merchant transmission project connecting Great Falls 230 kV substation to the Colstrip 500 kV Transmission System. The project consists of two 230 kV transmission circuits and a new Loco Mountain Substation with 230 to 500 kV transformation. There are no proposed generation resources associated with the transmission line.

**Cross-Tie Transmission Project**- TransCanyon, LLC is proposing the Cross-Tie Project, a 1,500 MW, 500 kV, series compensated, single circuit HVAC transmission project that will be constructed between central Utah and east-central Nevada. The project connects PacifiCorp's planned 500-kV Clover substation with NV Energy's existing 500 kV Robinson Summit substation; both substations reside in the NorthernGrid footprint.

**Southwest Intertie Project North (SWIP)-** Great Basin Transmission, LLC ("GBT"), an affiliate of LS Power, submitted the 275-mile northern portion of the Southwest Intertie Project (SWIP) to the California ISO and NorthernGrid. The SWIP-North Project connects the Midpoint 500 kV substation to the Robinson Summit 500 kV substation with a 500-kV single circuit AC transmission line. With the addition of NV Energy into the NorthernGrid footprint, the SWIP project is now fully within the NorthernGrid footprint. The SWIP is expected to have a bi-directional WECC-approved path rating of approximately 2000 MW.

## Sponsored Projects Request for Cost Allocation

The NorthernGrid Cost Allocation Task Force evaluated the information submitted by PowerBridge LLC, Great Basin Transmission LLC, and TransCanyon LCC. The committee determined each to be a Qualified Developer for their request for their Sponsored Project to be considered for cost allocation.

## Power Flow Case Development

Three Western Electricity Coordinating Council (WECC) power flow base cases were selected from the WECC published cases for the 10-year horizon. The 2032 heavy summer and 2031-2032 heavy winter were chosen to represent the two peak region load conditions. The 2031-2032 heavy winter and 2033 light spring were chosen for their ability to represent high power flow transfers from the eastern to western portions of the region. The resource dispatch in these base cases were adjusted as described below to reflect significant NorthernGrid region transmission stressing conditions.

## Power Flow Case Conditions

These cases were modified to achieve the following transmission stress conditions:

Summer Peak loading conditions. The 2032 Heavy Summer WECC base case was modified to have high southbound flows on the COI and PDCI, high eastbound Northwest to Idaho flows, and southbound MATL flows.

Winter Peak loading conditions. The 2031-2032 Heavy Winter WECC base case was modified to have typical seasonal dispatch for the generation resources, and northbound MATL flows.

California export case. The 2033 Light Spring case was modified to have high northbound flows on the COI and PDCI as well as 2032 loading for the NorthernGrid region.

High Wyoming wind export case. The 2031-2032 Heavy Winter WECC base case resource dispatch was modified to match a production cost model that resulted in peak Wyoming wind conditions. This condition occurred at noon December 11, 2032, in a NorthernGrid modified WECC 2032 Anchor Data Set Production Cost Model (ADS-PCM). NorthernGrid modified the ADS-PCM with the addition of the NorthernGrid submitted transmission projects.

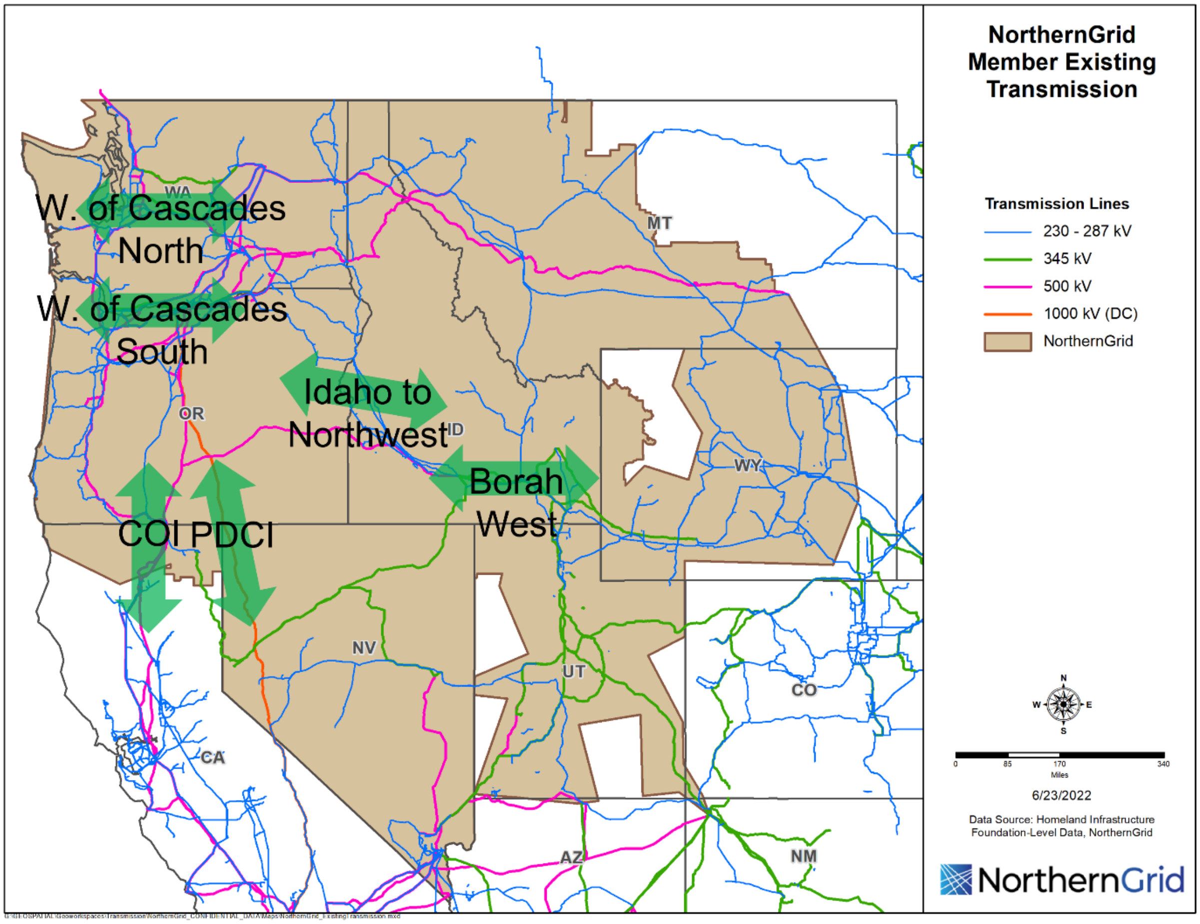


*Figure 4: Paths of interest in the NorthernGrid region*

Figure 4 above identifies the WECC paths of most interest to the NorthernGrid region for purposes of stressing the transmission system. Not all WECC paths relating to NorthernGrid are displayed, only those that are particularly useful in describing the flow patterns on the NorthernGrid transmission system for the different stressed conditions. The California-Oregon Intertie (COI) is needed for interregional transfers between the California Independent System Operator (CAISO) and NorthernGrid. West of Cascades, Idaho to Northwest, and Borah West are all key flowgates for transmitting energy from resources to loads within the NorthernGrid region and to California. The power flow case NorthernGrid region load, generation, and transmission path transfers are listed in Appendix G: Power Flow Case Summary Table 5.

## Contingencies and Criteria

Contingency analysis is the modeling of systematically removing specified transmission facilities from service and measuring the resulting impact to the transmission system.

Thermal overloads occur when the power flowing through a facility exceeds the capability of the facility which causes heat to build up; excess heat occurs which can then damage the facility. Typically, a thermal overload results from the loss of a transmission line or transformer. Operationally, there are multiple ways to mitigate thermal overloads. For example, remedial action schemes are designed to respond to specific events on the transmission system to help preserve reliability and load service; these actions are programmed and the outcomes to the transmission system are expected. Generators may be programmed to reduce their output in response to specific changes on the transmission system. These operational mitigation actions decrease the loading on the overloaded facility by either reducing the power or redirecting the power to facilities with larger capabilities.

Voltage excursions occur when the reactive support of the transmission system changes, as can happen during the loss of a facility. Voltage excursions can be high or low, either of which causes undue stress on the facility experiencing the excursion. Due to the interplay of all the facilities in a transmission system, the loss of any facility has the potential to cause a voltage excursion on the transmission system. Voltage excursions can be mitigated automatically through switching schemes on capacitor and/or reactor banks. Inserting capacitor banks acts to increase the voltage and inserting reactor banks acts to reduce the voltage. These switching sequences do not add further stress or burden to the transmission system as they compensate for the reactive need on the transmission system.

Members submitted regionally significant contingencies used for reliability analysis to develop the Plan. Contingencies on major WECC Paths relevant to the NorthernGrid region as well as contingencies on facilities in the 200 kV and above voltage classes were the primary focus. These regionally significant contingencies were selected for their criticality to the NorthernGrid region. The contingencies were categorized using Table 1 from NERC TPL-001-4. The post-contingency system analysis was performed using applicable NERC and WECC criteria while accounting for any member provided thermal or voltage criteria.

The NorthernGrid region as well as neighboring regions were monitored during the contingency analysis to determine if any negative impacts occur to the reliability of the transmission system due to the introduction of the regional projects. If negative impacts to the transmission system of neighboring regions could not be mitigated through operational changes for any regional combination, coordination would have to occur to identify the appropriate mitigation and the costs of that mitigation would be added to the cost of the regional project. No negative contingency results were observed in the neighboring regions and as such no Material Adverse Impacts were identified for any of the combinations considered.

## Evaluation of Regional Transmission Project Combinations

To determine whether transmission needs within the NorthernGrid may be satisfied by regional transmission projects, NorthernGrid evaluates the proposed regional and interregional (if any) transmission projects independently and in regional combinations. The regional combinations are determined by the MPC based on their knowledge of the NorthernGrid Region. A total of 26 regional combinations were evaluated. The regional combinations are shown in Appendix C: Full list of the Regional Combinations.

### Impacts on Neighboring Regions

As stated above, the power flow cases represent the entire western interconnection. Therefore, during the power flow analysis NorthernGrid will monitor for NERC standard and WECC criterion violations occurring in the neighboring regions. Upon identification of a violation in a neighboring region, NorthernGrid will coordinate with the region to confirm validity and whether the violation is due to an existing condition. Mitigation plans for a violation will be determined in accordance with the NorthernGrid Member tariffs and planning agreement.

### Selection of Projects

The objective of the regional transmission analysis is to identify a set of transmission projects that cost-effectively or efficiently meet the transmission service and reliability needs of the NorthernGrid region ten years in the future. To accomplish this goal, NorthernGrid started with base cases that include member planned future regional projects modeled as “in-service”, as displayed below in Figure 4. Planned future regional projects is an undefined term that generally refers to transmission projects that have been identified and possibly funded, but are typically not yet in construction. Collectively, these regional projects comprise the Baseline Member Projects, or the “BLMP”. Sensitivity cases based on combinations of various regional project components being systematically removed from the BLMP cases created a set of Regional Combination cases to test against the performance of the BLMP cases. While the BLMP includes the highest number of regional projects, the analysis will evaluate whether a subset of the BLMP may cost-effectively or efficiently meet the needs of the NorthernGrid region while maintaining system reliability.

After the contingencies were run, the raw counts of violations were ranked using weighting criteria developed by the NorthernGrid Member Planning Committee, Appendix C: Rankings. The rankings give less weight to those contingency categories that either have system adjustments available, can be addressed locally – such as reconfiguring a station to avoid a breaker failure issue, or have been determined to be less likely to occur. The results were further ranked by voltage class and severity of the violation; Appendix C: Rankings lists the full complement of ranking factors used.

The selection of the regional projects in the Plan is determined by the combination of projects that results in a transmission system that most cost-effectively or efficiently exceeds the reliability performance of the other possible combinations of submitted projects.

## Analysis Results

Once the base cases were updated to include the submitted loads, resources, and projects along with adjusting the generation dispatch to match the regional transmission flows described above, they were run through contingency analysis. When running contingency analyses, both the type of contingency and the impact of the contingency are vital to ascertaining the reliability of the transmission system. The type and the impact of the contingency are considered in conjunction with the voltage class of the facility. In general, an outage of higher voltage facilities has a greater impact on the transmission system than the loss of lower voltage facilities. From a NorthernGrid perspective, the contingencies that result in the loss of large amounts of load or the inability to honor transmission arrangements are those that are regionally significant and warrant further scrutiny.

To help identify regionally significant contingencies, each contingency result was multiplied by ranking factors: voltage class, type of the contingency, and the severity of contingency impact. An overall contingency ranking is the product of the sum of each ranking factor. The larger the resulting ranking, the more regionally significant the contingency. Voltage class refers to the kV rating of the facility: the larger the rating, the larger the ranking factor. Type of the contingency refers to the NERC TPL-001-4 criteria which is the guiding document used to classify all contingencies analyzed. The contingencies in NERC TPL-001-4 contain scenarios that range from outages of single facilities to severe outages that impact multiple facilities. It is quite common for a transmission system to have a single facility out of service, either planned or unplanned, and it is less common for a transmission system to experience events that result in the loss of multiple pieces of facility. Because of this, single outage contingencies were given a larger ranking factor than multi-outage contingencies. The impact of a contingency refers to what happens to the transmission system when a contingency occurs. Contingencies that caused minor violations were given a smaller ranking factor than those that led to major violations. From a NorthernGrid perspective, a minor violation is one that can be readily mitigated operationally with no anticipated damage to facility. A major violation may cause cascading outages or facility damage. Each contingency from each base case and each regional combination was ranked per the ranking factors. Ranked contingency results are unitless and are only used as a comparison of performance between power flow cases.

Figure 5 displays the summed rank of contingency violations for each regional combination. Regional combinations with the lowest sum of ranked violations represent better transmission reliability performance than those with higher values. Regional combination 12 provides the best reliability performance while regional combination 26 provides the worst performance for the given set of contingencies applied to the power flow cases.

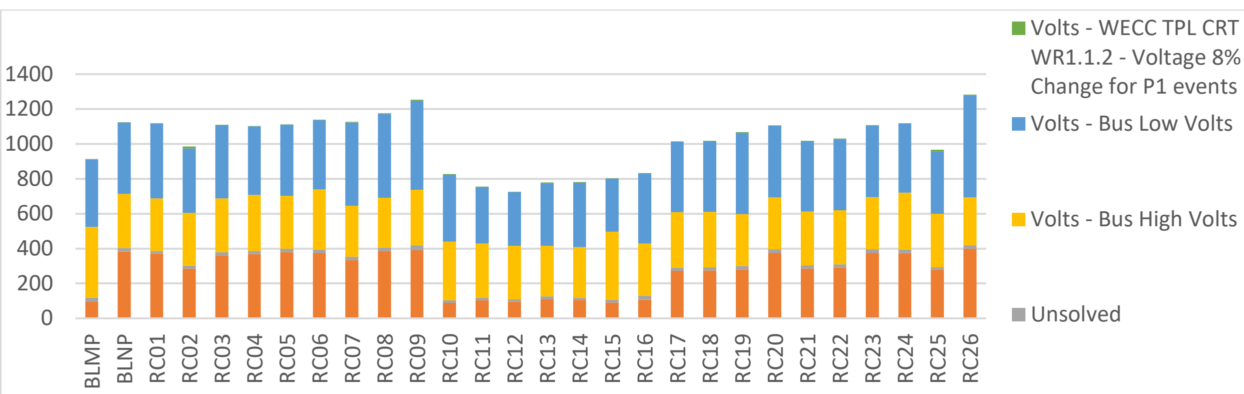


*Figure 5 Regional Combination Reliability Performance Chart*

# Regional Transmission Plan

The regional combination 12 composed of Boardman to Hemingway, Gateway West Phase 1, and Cascade Renewable Transmission Project received the most favorable contingency analysis ranking. A review of the violations identified that the eliminated violations changed from slightly above to slightly below the criteria threshold. When considering this minimal improvement and the additional project cost, the combination including the Cascade Renewable Transmission Project was deemed less cost effective than the regional combination 11 containing Boardman to Hemingway and Gateway West Phase 1. A cost allocation analysis was not required because no Qualified Developers' projects were selected into the Regional Transmission Plan. Figure 6 below depicts the projects that were determined to be the most efficient and cost-effective combination for the NorthernGrid region given the analysis performed as described in this report.

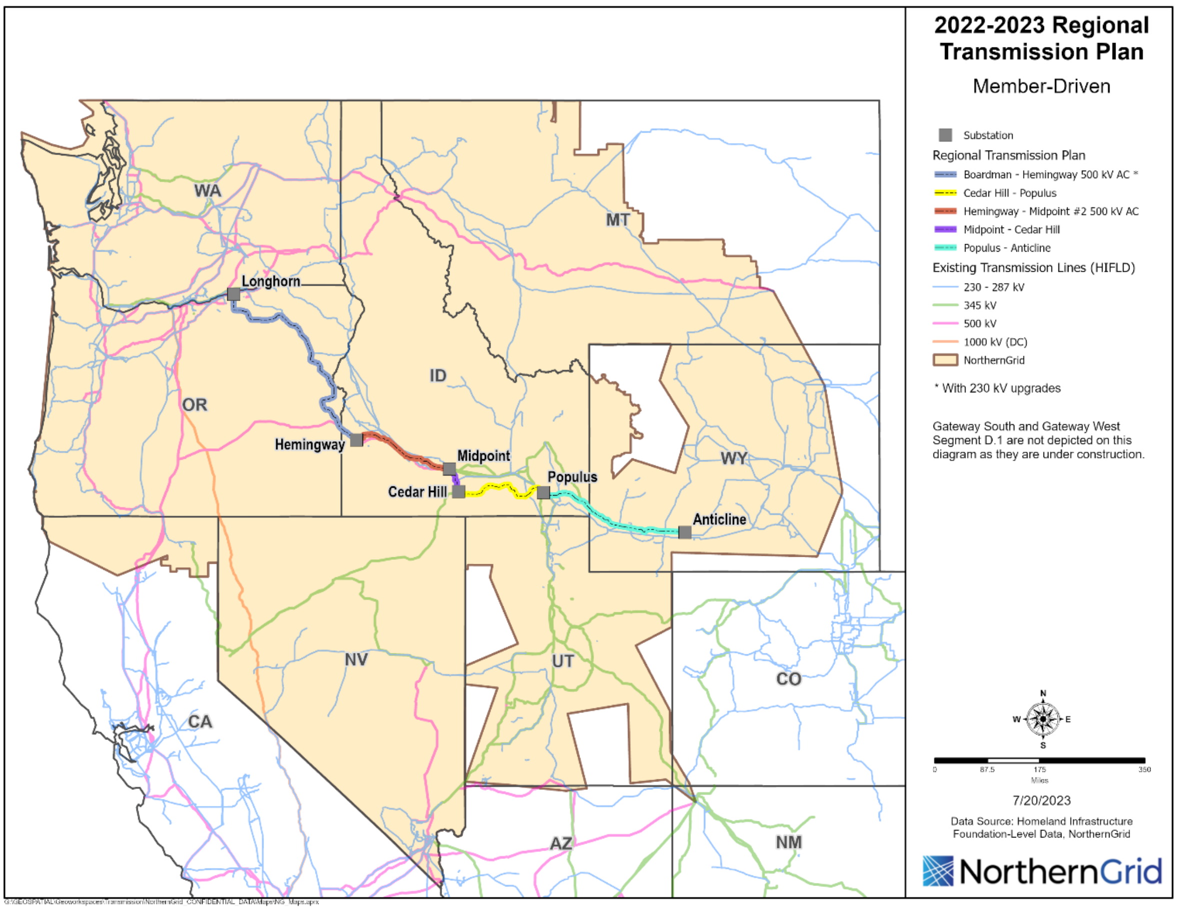


Figure 6: The Regional Transmission Plan for the 2022-2023 NorthernGrid cycle

Regional combination 11, depicted in Figure 6, forms the basis of the Regional Transmission Plan. The plan is composed of the Boardman – Hemingway, Hemingway – Midpoint #2, Midpoint – Cedar Hill, Cedar Hill – Populus, and Populus – Anticline projects. The route selected through southern Idaho changed from the last planning cycle from Hemingway – Cedar Hill – Populus to Hemingway – Midpoint – Cedar Hill – Populus. The construction sequencing change to the northern Gateway West sections west of Cedar Hill (Cedar Hill – Midpoint and Midpoint – Hemingway #2) was driven by recent changes in Idaho Power's load and resource forecasts. New industrial loads east of Boise and the need for the integration of anticipated renewable resources east of Boise necessitate the change. The more northern

Midpoint – Hemingway #2 line is closer to the new loads and existing lines where resources likely would integrate with the more built out network. The combination of Cedar Hill – Midpoint and Hemingway – Midpoint #2 is only approximately 8 miles longer than Cedar Hill – Hemingway. Therefore, the cost impact of the Gateway West sequencing change is limited. This selection of projects supports the NorthernGrid system for a 10-year future and is more efficient to build than the entire set of projects that comprise the BLMP.

## Impacts on Neighboring Regions

There were no Material Adverse Impacts within neighboring regions identified for any of the projects evaluated.

## Cost Allocation

The projects submitted for cost allocation consideration in the NorthernGrid region were not selected into the RTP. For this cycle, there are no projects that meet the criteria for cost allocation.

## Conclusion

The NorthernGrid planning effort for the 2022-2023 cycle culminated in the identification of a regional plan that is more efficient than a plan composed of a simple concatenation of all the Members' proposed projects. The transmission needs of the NorthernGrid transmission system: loads, resources, and regional projects including expected transmission arrangements, were provided by the Members which collectively formed the basis for the Study Scope. There were no projects submitted for cost allocation consideration selected into the Regional Transmission Plan. NorthernGrid analyzed 112 different power flow cases where each base case represented a selected hour combined with a selected set of transmission projects. Altogether, the set of transmission projects that resulted in a more efficient transmission system is that identified as regional combination 11.

# Appendix A: Definitions and Terms

Attachment K from NorthWestern Energy is provided here for reference to the process or definitions and can be accessed by double-clicking on the icon.

# Appendix B: Study Scope

The entire study scope for the 2022-2023 cycle can be accessed by double-clicking the icon below or by clicking on this link: northerngrid.net/private-media/documents/NG_Study_Scope_2022-2023_Approved.pdf

# Study Scope for the 2022-2023 NorthernGrid Planning Cycle

*Member Planning Committee Approval Date: September 21, 2022*

# Appendix C: Rankings

*Table 1: Voltage Class for Ranking*

| From | To | Rank |
|---|---|---|
| 0 kV | 50 kV | 0.1 |
| 50 kV | 100 kV | 0.1 |
| 100 kV | 200 kV | 0.3 |
| 200 kV | 300 kV | 0.5 |
| 300 kV | 400 kV | 0.8 |
| 400 kV | 1000 kV | 1 |

*Table 2: NERC TPL Category for Ranking*

| Category | Rank | Description |
|---|---|---|
| P0 | 1 | All lines in service |
| P1 | 0.5 | Single element loss results in single element outage |
| P2 | 0.1 | Single element loss results in multiple element outage |
| P3 | 0.075 | Loss of generator followed by system adjustments |
| P4 | 0.1 | Stuck breaker results in multiple element outage |
| P5 | 0.1 | Delayed fault clearing results in multiple element outage |
| P6 | 0.075 | Loss of single element followed by system adjustments |
| P7 | 0.1 | Multiple element loss results in multiple element outage |

*Table 3: Violations for Ranking*

| LV_Type | Rank | Description |
|---|---|---|
| Interface MW | 0.5 | Mild overload of path rating. |
| Interface MW | 1 | Heavy overload of path - potential stability problems. |
| Branch Amp | 0.5 | Mild overload of line. |
| Branch Amp | 1 | Heavy overload of line. Possibility of automated tripping. |
| Branch MVA | 0.5 | Mild overload. |
| Branch MVA | 1 | Heavy overload. |

# Appendix D: Complete list of all RC combos

*Table 4 Working version of the Regional Combinations Table*

| RC Name | BLMP | BLNP | RC01 | RC02 | RC03 | RC04 | RC05 | RC06 | RC07 | RC08 | RC09 | RC10 | RC11 | RC12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CCX | | | x | | | | | | | | | x | | x |
| B2H | x | | | x | | | | | | | | x | x | x |
| GWW D.3 | x | | | | x | | | | | | | x | x | x |
| GWW Phase 2 | x | | | | | | | | | | | x | | |
| GWW Phase 1 | x | | | | | x | | | | | | x | x | x |
| GWW D.1 | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| GWS F | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| ON2 | x | | | | | | x | | | | | x | | |
| GNLK N-W | x | | | | | | | x | | | | x | | |
| CrossTie | | | | | | | | | x | | | x | | |
| SWIP-N | | | | | | | | | | x | | x | | |
| Loco Falls | | | | | | | | | | | | x | | |
| MATL | x | | | | | | | | | | x | x | | |
| RobinsonPS | | | | | | | | | x | x | | x | | |
| ON1SC | | | | | | | | | x | x | | x | | |

| RC Name | RC13 | RC14 | RC15 | RC16 | RC17 | RC18 | RC19 | RC20 | RC21 | RC22 | RC23 | RC24 | RC25 | RC26 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CCX | | x | | | | | | | | | | | x | |
| B2H | x | x | x | x | | | | | | | | | x | |
| GWW D.3 | x | x | x | x | | | | | | | | | | |
| GWW Phase 2 | | | x | | | | | | | | | | | |
| GWW Phase 1 | x | x | x | x | | | | | | | | | | |
| GWW D.1 | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| GWS F | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| ON2 | | | | | x | | x | x | x | | | x | | |
| GNLK N-W | | | | | x | x | | x | x | x | x | x | | |
| CrossTie | | | | | x | x | x | | x | x | | | | |
| SWIP-N | x | x | | | x | x | x | x | | | x | | | |
| Loco Falls | | | | | | | | | | | | | | x |
| MATL | | | | x | | | | | | | | | | x |
| RobinsonPS | x | x | | | x | x | x | x | x | x | x | | | |
| ON1SC | x | x | | | x | x | x | x | x | x | x | | | |

Project Abbreviations

CCX – Cascade Renewable Transmission Project

B2H – Boardman to Hemingway Transmission Project

GWW – Gateway West Transmission Project

D.3 Anticline to Populus

Phase 1 – Hemingway – Midpoint #2, Midpoint – Cedar Hill, Cedar Hill – Populus segments

Phase 2 – Hemingway – Cedar Hill, Midpoint – Borah 345 to 500 kV, Borah – Populus segments

D.1 Windstar to Aeolus 500 kV segment (under construction)

GWS F – Gateway South Transmission Project

ON2 – One Nevada "Online" Phase 2 Transmission Project

CrossTie – Cross-Tie Transmission Project

GNLK N-W – Green Link Northwest Transmission Project

SWIP-N – Southwest Intertie Project – North

MATL – Montana Alberta Transmission Line Upgrade Project

RobinsonPS – Robinson Summit Phase Angle Regulating Transformer "Phase Shifter" Project

ON1SC – One Nevada "Online" Phase 1 Series Compensation Addition

# Appendix F: NorthernGrid Contingencies

The entire list of contingencies analyzed can be accessed by double-clicking the icon below.

# Appendix G: Power Flow Case Summary

*Table 5 Power Flow Case Load, Generation, and Path Transfer Summary*

| Base Case Name | Generation (MW) | Load* (MW) | West of Cascades -North (MW) | West of Cascades -South (MW) | Idaho-to-Northwest (MW) | Borah West (MW) | Pacific DC Intertie (PDCI) (MW) | California-Oregon Intertie (COI) (MW) |
|---|---|---|---|---|---|---|---|---|
| 32HS | 61,539 | 57,308 | 4,209 | 3,984 | -2,204 | 197 | 2,712 | 3,793 |
| 32HW | 61,539 | 53,000 | 7,272 | 5,041 | -890 | 364 | -1500 | 901 |
| 32HW PCM | 61,539 | 55,832 | 4,936 | 3,598 | 2851 | 3691 | 491 | 264 |
| 32LSP | 31,603 | 35,151 | 4,057 | 2,682 | 901 | 756 | -938 | -2,728 |

*Load: The NorthernGrid load represented in the table above may or may not reflect station service loads or third-party loads served by NorthernGrid members.