ColumbiaGrid

2012 Update to the 2011 Biennial Transmission Expansion Plan

Approved by the ColumbiaGrid Board of Directors on February 15, 2012

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Seattle City Light
Snohomish County PUD
Tacoma Power

Other Contributors
Idaho Power Company
Northern Tier Transmission Group
Northwest Power and Conservation Council
Northwest Power Pool
Northwestern Energy
PacifiCorp
Portland General Electric

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Executive Summary

The ColumbiaGrid 2012 Update to the 2011 Biennial Transmission Expansion Plan (Expansion Plan Update) looks out over a ten-year planning horizon (2012 - 2022) and identifies the transmission additions necessary to ensure that the parties to the ColumbiaGrid Planning and Expansion Functional Agreement can meet their commitments to serve load and meet firm transmission service commitments.

Since the adoption of the 2011 Biennial Transmission Expansion Plan, the following information has become available and is incorporated into this Expansion Plan:

1) In July 2011, ColumbiaGrid staff completed its 2011 System Assessment which highlighted areas of the system where there may be deficiencies in meeting reliability standards. Thirteen areas of concern were identified that affect more than one ColumbiaGrid Planning Participant. Most of these concerns will be addressed by existing study teams. Five of these areas of concern may require the creation of new study teams if existing utility efforts to resolve the issues are not successful.

2) The 2011 System Assessment identified the need for the following sensitivity studies which are documented in this report

a. Further study of voltage stability issues and unsolved outages from the System Assessment:
b. Five Year Light Load Case
c. Ten Year Winter Case
d. N-1-1 500 kV Outage Sensitivity
e. Custer Ring Bus Modeling
f. Natural Gas Limitations resulting from an Extended Winter Peak Load Event
g. Wind Sensitivity Studies

3) On October 28, 2011, The Puget Sound Area Study Team completed an update to the Transmission Expansion Plan for the Puget Sound area. The purpose of the original plan was to provide reliable service

to area loads and substantially reduce the need for curtailment of transfers between the Northwest and Canada. The update modified the plan to account for changes to load service needs in the area.

4) The Northern Mid-Columbia Study Team continues its work to resolve the cost allocation and ownership issues related to the preferred plan of service (Rapids-Columbia 230 kV line).

5) The Cross Cascades Study Team continued its investigation and comparison of alternatives to increase the West of Cascades North path capacity. This is primarily a concern during heavy winter loading conditions.

6) Centralia Shutdown Study Team identified the transmission implications associated with the proposed closure of the Centralia Power Plant. A report of its effects was completed in April 2008 by ColumbiaGrid.

7) Development activities are ongoing for a large number of potential major transmission projects that could affect the northwest transmission system. Updated information on these projects is provided in this report.

ColumbiaGrid has documented all of the above in this Expansion Plan Update which has been reviewed by the various study teams and other interested stakeholders. With the completion of this Expansion Plan Update, ColumbiaGrid will initiate the 2012 System Assessment cycle which is scheduled for completion in July 2012.

Draft Resolution to adopt the
2012 Update to 2011 Biennial Transmission Expansion Plan

WHEREAS, a purpose of ColumbiaGrid is carrying out the ColumbiaGrid Planning and Expansion Functional Agreement ("PEFA"), which is intended to support and facilitate multi-system planning through a coordinated, open, and transparent process and is intended to facilitate transmission expansion based upon such planning; and

WHEREAS, pursuant to Article 2.1 of the PEFA, each Planning Cycle, ColumbiaGrid shall develop and review a Draft Biennial Plan and shall adopt, by majority vote of the ColumbiaGrid Board of Directors, a Biennial Plan; and

WHEREAS, ColumbiaGrid has prepared a Draft 2012 Update to the 2011 Biennial Transmission Expansion Plan for the years 2012-2022 ("2012 Transmission Expansion Plan Update") based on the ColumbiaGrid planning process and posted this plan for public review and comment on December 29, 2011; and

NOW, THEREFORE, BE IT RESOLVED that, based upon the ColumbiaGrid Board of Directors' review of the 2012 Transmission Expansion Plan Update on its technical merits, the consistency of the Projects listed in the Transmission Expansion Plan Update with the PEFA, and considering comments and information provided during the review process, the ColumbiaGrid Board of Directors hereby adopts the 2012 Update to the 2011 Biennial Transmission Expansion Plan, as revised February 2012 and including comments discussed at February 15, 2012 Board of Directors meeting.

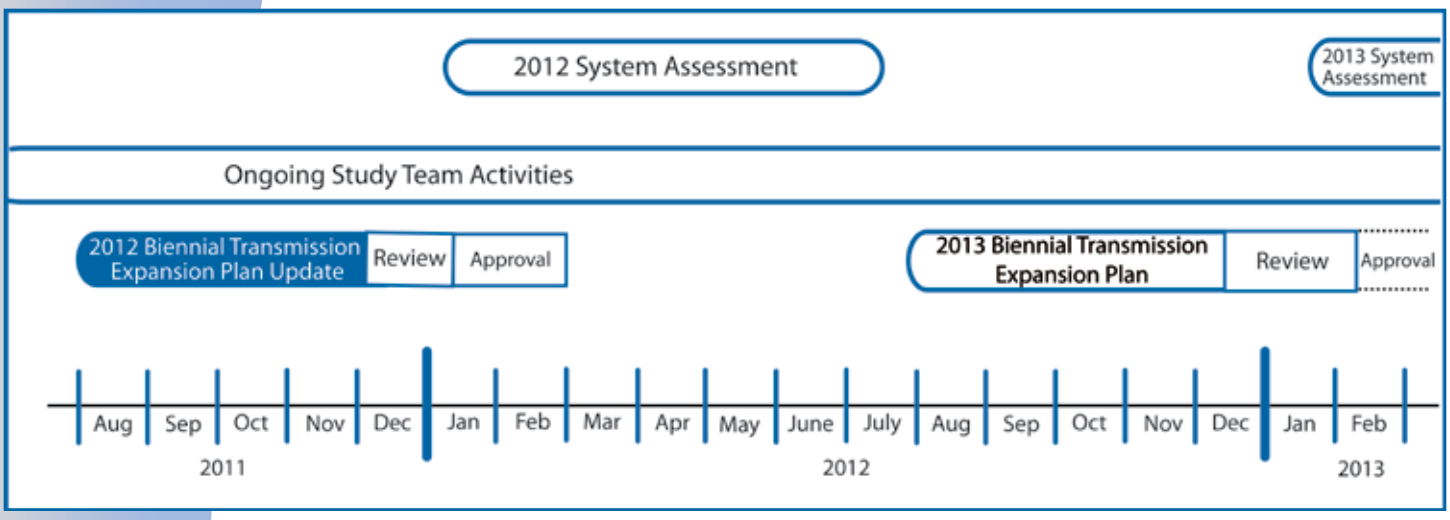


Figure B-1: Process Timeline

Introduction

ColumbiaGrid was formed with seven founding members in 2006 to improve the operational efficiency, reliability, and planned expansion of the northwest transmission grid. Eleven parties have signed ColumbiaGrid's Planning and Expansion Functional Agreement (PEFA) to support and facilitate multi-system transmission planning through an open and transparent process. ColumbiaGrid's primary grid planning activity is to develop a biennial transmission expansion plan that looks out over a ten-year planning horizon and identifies the transmission additions necessary to ensure that the parties to the ColumbiaGrid Planning and Expansion Functional Agreement can meet their commitments to serve load and transmission service commitments. A significant feature of the transmission expansion plan is its single-utility planning approach. The plan has been developed as if the region's transmission grid were owned and operated by a single entity. This approach results in a more comprehensive, efficient, and coordinated plan than would otherwise be developed if each transmission owner completed a separate independent analysis. In the years between the production of biennial plans, ColumbiaGrid may produce an update to the biennial plan if warranted based on changes in transmission plans.

Ten-year Plan

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 in the permitting, design, or construction phases. The projects in the plan may have been generated in a variety of forums such as System Assessments, studies completed by the study teams, or individual planning participant studies. ColumbiaGrid's Ten Year Plan is shown in Figure B-1 and Table B-2 (on the following page). More detailed information for each of the projects is provided in Attachment B of this report. Changes in this Plan from the prior plan update are also noted along with estimated costs for the ColumbiaGrid member projects. Projects from the previous Ten Year Plan that have since been energized are shown in Table B-1.

The ColumbiaGrid ten-year plan has been coordinated directly with other sub-regional planning groups (e.g., the Northern Tier Transmission Group) and with the overall region through the Western Electricity Coordinating Council (WECC). In 2011, WECC completed an overall ten year plan for the western interconnection (2011 WECC 10-Year Regional Transmission Expansion Plan). The previous ColumbiaGrid ten-year plan was part of the foundation for this interconnection-wide plan.

The projects in the ColumbiaGrid ten-year plan primarily address issues that occur in the first five years of the ten-year planning horizon. Additional projects will be required to meet the needs in the latter part of the ten-year planning horizon. These additional projects are still being developed as there is sufficient time to study these areas and refine the projects that will address those needs. Several of the long-term needs that may generate additional transmission projects are described below:

1. West of Cascades North and South

Several projects have been identified to reinforce these two paths to meet load growth and transfer east side resources to the west side load areas. These projects include:

a. Series capacitors at Schultz Substation - Bonneville is analyzing the need for additional series capacitors on the Schultz-Raver #3 and #4 500 kV lines to increase capacity on the West of Cascades North path.

b. Cascade Crossing Project – This Portland General Electric project would reinforce the West of Cascades South path and includes a Grassland-Bethel 500 kV double circuit line from the Boardman area west into the Salem area.

c. The Cross Cascades North Study Team is investigating the incremental benefit of other projects including additional 500 kV lines across the West of Cascades North path.

2. North King County 230/115 kV Transformation and Capacity Increase

In addition to the Lakeside transformer in the Ten Year Plan, Puget Sound Energy is also planning additional 230/115 kV transformation at Lake Tradition in the long term.

Table B-1: Projects Energized Since the Previous Plan

Projects Completed		
John Day - McNary 500 kV Line	Bonneville Power	$247 Million
Mid-Columbia Area Reinforcement (Vantage-Midway 230 kV line upgrade) and 230 kV sectionalizing breakers at Vantage and Midway Substations	Bonneville Power	$14 Million
Second 230/115 kV transformer at Redmond Substation	Bonneville Power	$12 Million
Bakeoven Series Capacitors plus other shunt capacitors and line up-grades (COI Upgrade)	Bonneville Power	$64 Million
Rebuild McKenzie-Wenatchee Tap 115 kV line	Chelan County PUD	$6 Million
Horse Ranch 230 kV Substation	Puget Sound Energy	$38 Million
Canyon Substation and 230/115 kV transformer (Tacoma area)	Tacoma Power	$10 Million
Cowlitz 230/115 kV transformer replacement (second bank)	Tacoma Power	$7 Million
	Energized Total	**$404 Million**

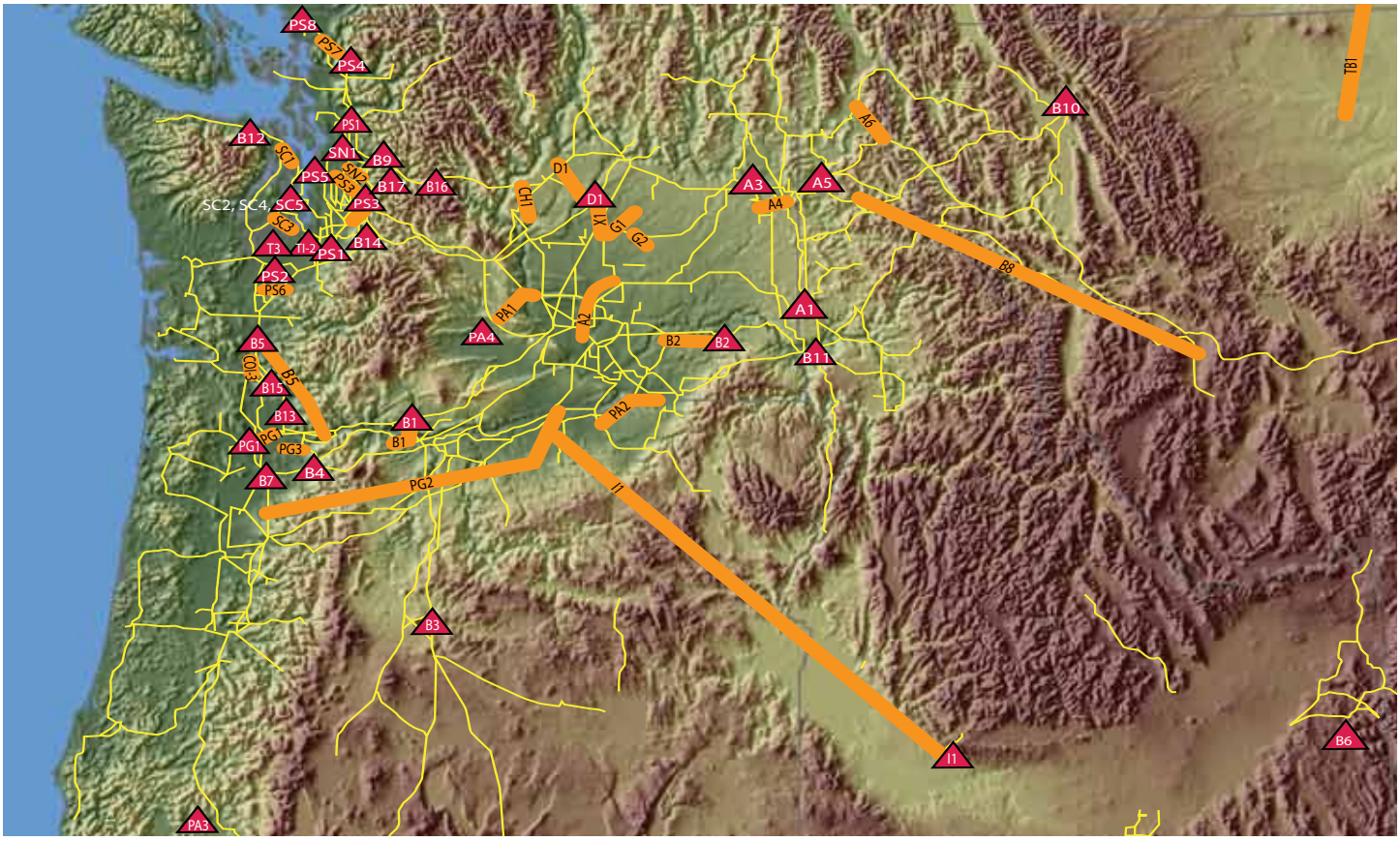


Figure B-2: ColumbiaGrid Ten-Year Plan

Table B-2: ColumbiaGrid Ten-Year Plan

	Project Name	Sponsor	Date	Change from Previous Plan	Estimated Cost
A1	Moscow 230 kV Substation Rebuild and Transformer Replacement	Avista	2012	2013	$15 Million
A2	Benton-Othello 115 kV Line Upgrade	Avista	2013	New Project	
A3	Westside 230 kV Rebuild and Transformer Upgrades	Avista	2014	New Project	
A4	Irwin Project - Spokane Valley Transmission Reinforcements	Avista	2013	New Project	
A5	Lancaster Combustion Turbine Project Integration	Avista	2013	New Project	
A6	Bronx - Cabinet 115 kV Line Rebuild	Avista	2015	New Project	
B1	Big Eddy-Knight 500 kV line connecting to the existing Wautoma-Ostrander 500 kV line at the new Knight Substation	Bonneville Power	2013		$182 Million
B2	Central Ferry - Lower Monumental 500 kV line and connection to existing Lower Granite - Lower Monumental 500 kV lines at the new Central Ferry Substation	Bonneville Power	2013		$99+ Million
B3	Ponderosa 500/230 kV #2 Transformer Addition	Bonneville Power	2013		$31 Million
B4	Ostrander 500/230 kV transformer addition (replacing McLoughlin transformer, converting Ostrander-McLoughlin 500 kV line to 230 kV operation) and Ostrander Breaker addition	Bonneville Power/PGE	Tranf: 2012 Breaker: 2014		$31 Million
B5	Castle Rock - Troutdale 500 kV line (I-5 Corridor Reinforcement Project) connected to the Paul-Allston line at the new Castle Rock Substation	Bonneville Power	2016	2015	$340 Million
B6	Lower Valley Reinforcement	Bonneville Power	2013		$48 Million
B7	Double breaker, double bus at Pearl 500 kV Substation	Bonneville Power	2013	2015	$4 Million
B8	Colstrip Upgrade Project (Garrison West)	Bonneville Power	2015	New Project	
B9	Monroe Substation 500 kV Caps	Bonneville Power	2013-2014	New Project	$9.1 Million

	Project Name	Sponsor	Date	Change from Previous Plan	Estimated Cost
B10	Columbia Falls 230 and 115 kV Bus Reliability Improvements	Bonneville Power	2013-2015	New Project	$4 Million
B11	Hatwai 230 kV Bus Reliability Improvements	Bonneville Power	2015		$4.2 Million
B12	Port Angeles 230 kV Bus and 230/69 kV Transformer or non-wires project	Bonneville Power	2014		$15 Million
B13	Keeler 230 kV Bus Reliability Improvements	Bonneville Power	2014	2012	$2.3 Million
B14	Add a Raver 500/230 kV Transformer	Bonneville Power	2016		
B15	Longview-Lexington 230 kV Line Retermination into Longview Annex	Bonneville Power	2015	2014	$1.1 Million
B16	Extend Northern Intertie RAS for the combined loss of Monroe-SnoKing-Echo Lake and Chief Joseph-Monroe 500 kV lines	Bonneville Power	2016	New Project	$3 Million
CH1	Rerating of Andrew York-McKenzie 115 kV #1 and #2 lines	Chelan County PUD	2013	2012	$.5 Million
CO1	Longview-Cowlitz #2 upgrade from 69 kV to 115 kV	Cowlitz County PUD	2011-2012		$2.6 Million
CO2	Longview-Lexington #2 upgrade from 69 kV to 115 kV	Cowlitz County PUD	2013-2014		$4.9 Million
CO3	Longview-Lexington-Cardwell upgrade from 69 kV to 115 kV	Cowlitz County PUD	2015-2017		$10.1 Million
D1	Douglas - Rapids 230 kV line and Rapids 230/115 kV Substation	Douglas County PUD	2013		$16 Million
G1	Columbia - Larson 230 kV line	Grant County PUD	2014		$42 Million
G2	Rocky Ford-Dover 115 kV line	Grant County PUD	2016	2014	$5 Million
I1	Hemingway - Boardman 500 kV line	Idaho Power/BPA/PAC	2016		$820 Million
PA1	Wanapum - Pomona Heights 230 kV line (Yakima area)	PacifiCorp	2013		
PA2	Wallula-McNary 230 kV line	PacifiCorp	2012-2013		
PA3	Whetstone 230/115 kV Substation in Medford area	PacifiCorp	2013		
PA4	Union Gap 230/115 kV transformer #3 in Yakima area	PacifiCorp	2013		
PG1	Keeler - Horizon 230 kV line with 230/115 kV transformer at Horizon Substation	Portland General Electric	2012		
PG2	Cascade Crossing (Coyote-Boardman-Bethel 500 kV line)	Portland General Electric	2017	2015	
PG3	Blue Lake - Gresham 230 kV line	Portland General Electric	2017		
PS1	Alderton 230/115 kV Transformer in Pierce County	Puget Sound Energy	2014	2012	$28 Million
PS2	St Clair 230/115 kV Transformer in Thurston County Transformer	Puget Sound Energy	2013		$30 Million
PS3	Rebuild Sammamish-Lakeside-Talbot 115 kV lines and energize one at 230 kV, install a new 230/115 kV Transformer at Lakeside	Puget Sound Energy	2015-2017		$70 Million
PS4	Sedro Woolley Substation 230/115 kV transformer addition (#2) in north Puget Sound area	Puget Sound Energy	2012		$9.4 Million
PS5	Sammamish Bus Reliability Improvements	Puget Sound Energy	2012	New Project	$1 Million
PS6	Woodland-St Clair 115 kV Line	Puget Sound Energy	2015	New Project	$13 Million
PS7	Sedro Woolley-Bellingham #4 115 kV Line Reconductor	Puget Sound Energy	2015	New Project	$14 Million
PS8	Add a Second Portal Way 230/115 kV Transformer and Line Upgrades	Puget Sound Energy/BPA	2015-2016	New Project	$18 Million
SC1	Reconductor Bothell-SnoKing 230 kV Double Circuit Line	Seattle City Light/BPA	2016	New Project	$3 Million
SC2	Add Series Inductors to Broad Street-Union-Massachusetts and Broad Street-Denny 115 kV Underground Transmission Cables	Seattle City Light	2016	New Project	$13 Million
SC3	Reconductor Delridge-Duwamish 230 kV Line	Seattle City Light	2016	New Project	$2 Million
SC4	Denny Substation (previously NODO Substation)	Seattle City Light	2016	New Project	$150 Million
SC5	Upgrade Denny Substation Transmission	Seattle City Light	2019	New Project	$50 Million
SN1	Beverly Park Substation 230/115 kV Transformer addition (North Puget Sound)	Snohomish County PUD	2014	2012	$25 Million
SN2	Beverly Park and South Snohomish County 115 kV Expansion	Snohomish County PUD	2014	2012	
T1	Cowlitz 230 kV Line Retermination Project	Tacoma Power	2012		$1 Million
T2	Cowlitz 230 kV Substation Reliability Improvement Project	Tacoma Power	2015-2016	2013-2014	$3 Million
T3	Southwest 230 kV Substation Reliability Improvement Project	Tacoma Power	2013-2014	2016	$3.0 Million
TB1	Montana Alberta Tie Ltd Project	Enbridge	2012-2013	2011	$209 Million
x1	Rapids - Columbia 230 kV line (Mid-Columbia area)	undetermined	2015		$18 Million
		Total of all ColumbiaGrid Projects			**$2350 Million**

3. North Downtown Seattle

Seattle City Light is planning a new substation in the northern portion of downtown Seattle to serve load growth, improve reliability and increase system flexibility. In Phase 1, the substation will bisect the existing East Pine to Broad Street underground cable. In Phase 2, the project construction will include a new 115 kV transmission line from Massachusetts Substation to the new substation. This project was studied in previous years.

4. Mid-Columbia Area Reinforcement

Grant County PUD is contemplating additional reinforcements between the Wanapum and Midway 230 kV Substations in central Washington.

5. Lewiston Reinforcements

A second Lolo-Hatwai 230 kV line is one solution to increase capacity to meet Avista load growth and for operational flexibility.

6. Chemawa 230/115 kV transformer additions

Additional transformation is expected to be necessary in the north Salem area to meet growing Bonneville loads.

7. Kalama Energy

A new 230 kV line from Kalama to Longview is being considered by Cowlitz PUD to connect a 346 MW gas fired generation plant to the system and provide for load growth in the area.

8. Horizon Phase II

The new Horizon-Trojan 230kV line could provide additional capacity on the South of Allston path to assist in delivering new generation adjacent to Port Westward to Portland General Electric loads in the west Portland area. In addition, a second 230/115kV bulk power transformer is planned to be installed at Horizon substation.

As these proposed projects mature into committed plans to meet these long-range needs, they will be incorporated into future ColumbiaGrid ten-year plans.

Joint Areas of Concern

The 2011 System Assessment identified several planning areas with needs that require multiple utility studies during this planning cycle. Two of these areas, the Eastern Washington/Northern Idaho and Olympic Peninsula studies have not been launched as the affected parties are attempting to address these concerns on their own. Other identified problems fit into existing study team efforts. All of these areas involve load service issues with impacts to ColumbiaGrid participants. Projects that are developed to address these concerns would typically be characterized as Existing Obligation Projects under PEFA. Projects to mitigate these issues are in various stages of development. Some are well defined with firm commitments from the responsible utilities. Others are still in the conceptual stage. Future Biennial Plans will include updates to these projects as they become available.

The transmission deficiencies identified in the 2011 System Assessment include:

1. Northern Olympic Peninsula: Voltage instability in the Port Townsend and Port Angeles area may occur for loss of either Shelton-Fairmount 230 kV #1 or #2 line or loss of both lines (on double circuit towers). BPA is investigating a demand response alternative, a substation upgrade, and a load tripping scheme (for severe contingencies).

2. Olympia-Shelton Area: The loss of Shelton 230 kV bus sections may cause voltage instability in the area during winter conditions. Facilities in the area are owned by BPA, PSE and Tacoma Power and these three utilities have an ongoing effort to address these issues so a ColumbiaGrid Study Team is not needed. A bus reconfiguration at Shelton could mitigate this problem.

3. Puget Sound 500/230 kV transformer overloads: Several N-2 line outages cause the Covington 500/230 kV transformer to overload during winter peak load conditions. This problem has been identified in previous system assessments. The Puget Sound Transmission Expansion Plan included a project to add a transformer at Covington to resolve this issue. BPA is planning to complete this project although they are revising the plan to add the transformer at Raver Substation which would be an equally effective mitigation plan.

4. Centralia Area (Paul-Tono Phase shifter overloads): Outages of the N-2 Paul-Olympia-Satsop 500 kV lines results in voltage stability issues and overloads the Paul-Tono phase shifter in winter cases. These facilities are owned by PSE and BPA. These facilities are located in the Puget Sound area and fit within the current Puget Sound Area Study Team efforts. PSE current operating procedures are to adjust the phase angle tap setting in real time to maintain power flow within the transformer rating.

5. Interaction of Proposed Cascade Crossing Project: N-2 outages of the 500 kV lines between Salem and Eugene (Marion-Alvey and Marion-Lane), outages of the Santiam and Alvey 230 kV busses and several other

lower voltage outages cause overloads in the Salem-Eugene area in the outer year cases when the proposed Cascade Crossing project is modeled. Since these overloads did not occur in the earlier cases without the project and since these loadings are significantly higher with the project, interaction with the Cascade Crossing Project is likely. Further project coordination will be needed as this project is developed but since this is an issue between BPA, PGE and PacifiCorp, no study team is proposed. BPA has preliminary plans to add a bus section breaker at Santiam which would resolve some of these issues. Load tripping in the Newport, Oregon area could resolve the remaining issues.

6. Interaction of Proposed I-5 Corridor Project: BPA is planning to build the I-5 Corridor project which is a line from the new Castle Rock Substation to Troutdale Substation. PGE is also planning to reinforce their system between Troutdale and Gresham by building a Blue Lake-Gresham 230 kV line. Both of these projects appear to correct the problems they were designed to mitigate, however there is an interaction between these two projects that creates some new transmission issues. The single Gresham-Linneman 230 kV line and the N-2 Gresham-Troutdale/Linneman-Troutdale 230 kV outage cause the Blue Lake-Troutdale 230 kV and Blue Lake-Gresham 230 kV lines to overload. There are also 230/115 kV transformer overloads in the area for various N-1 line outages. These overloads only occur with both the Blue Lake-Gresham and I-5 Corridor Projects energized in the longer term cases. Subsequent information from PGE indicates that they are proposing to reconductor the Blue Lake-Troutdale line and use larger conductor on the new Blue Lake-Gresham line which will mitigate these transmission issues. Further project coordination will be needed as these projects are developed but since this is an issue between BPA, PGE and PacifiCorp, no ColumbiaGrid study team activity is planned.

7. Pearl-Sherwood Area: Several 230 kV lines in the McLoughlin-Pearl-Sherwood area overload for parallel outages in the winter cases. Also, the McLoughlin and Sherwood 230/115 kV transformers overload for these same 230 kV line outages. PGE and BPA are planning a reconfiguration project between Pearl and Sherwood to separate these double circuit lines with individual circuit breakers which would resolve this issue. The timing of this project is dependent on forecasted load in this area. Since this is an issue between BPA and PGE, no ColumbiaGrid study team activity is planned.

8. Salem-Eugene area: Outages of the Santiam-Wren 230 kV line or the Santiam 230 kV bus section breaker could cause voltage stability issues in the Salem-Eugene area. BPA has preliminary plans to add a bus section breaker at Santiam and mitigation for the line outage. These problems involve outages of BPA facilities and could cause problems for Bonneville, Portland General Electric and PacifiCorp equipment. BPA has preliminary plans to add a bus section breaker at Santiam which would resolve some of these issues. Load tripping in the Newport, Oregon area could resolve the remaining issues. These voltage stability issues were also studied as sensitivities in this 2012 Biennial Plan. Since this is an issue between BPA, PGE and PacifiCorp, no ColumbiaGrid study team activity is planned.

9. Bend Area Voltage Stability: The N-2 outage of Pilot Butte-Redmond/Pilot Butte-Ponderosa 230 kV lines causes potential voltage stability in the Bend area in all base cases. This is an issue for BPA and PacifiCorp to resolve. These voltage stability issues were also studied further in the sensitivity studies for this Biennial Plan. Since this is an issue between BPA and PacifiCorp, no ColumbiaGrid study team activity has taken place. With the new proposed changes to the WECC Planning Criteria, this outage may no longer require mitigation.

10. Benton AVA-Taunton-South Othello 115 kV line overloads: An issue was identified in the 2010 and 2011 System Assessments where several outages around Larson, Frenchman Hills and Warden cause the Benton AVA-Taunton-South Othello 115 kV line to overload in the ten-year winter and summer cases. Although these facilities are owned by Grant and Avista, Bonneville, Douglas and Chelan have nearby transmission that could be impacted by the resolution of this problem. Avista now has plans in its budget to reconductor this line. This upgrade plan will be included in future system assessments.

11. Spokane Area Transformation: Bonneville's Bell and Avista's Beacon 230/115 kV transformers overload for outages of the Beacon South 230 kV bus. These facilities are owned by Avista and Bonneville and these utilities have an ongoing effort to address this issue so a ColumbiaGrid Study Team is not needed. Additional transformation is envisioned by Avista at Garden Springs Substation with new 230 kV lines to Westside, Beacon and/or Boulder Substations in south Spokane to meet growing loads.

12. Moscow/Pullman area Transformation Overloads: These facilities are owned by Avista and Bonneville. A transformer replacement at Moscow is underway by Avista to mitigate these overloads.

13. Sandpoint Area: Libby 230 kV line outages and local 115 kV outages in the Cabinet Gorge, Albeni Falls and Libby areas are causing 115 kV overloads between Cabinet Gorge, Sandpoint and Albeni Falls in the ten-year summer and winter cases. These facilities are owned by Avista and Bonneville and these utilities have ongoing efforts to address this issue so a ColumbiaGrid Study Team is not needed. Avista has plans underway to reconductor the Bronx-Cabinet 115 kV line. Additional redispatch may be required at Libby to completely resolve these issues. Avista and Bonneville have relied on a sectionalizing scheme at Sand Creek to help mitigate these problems.

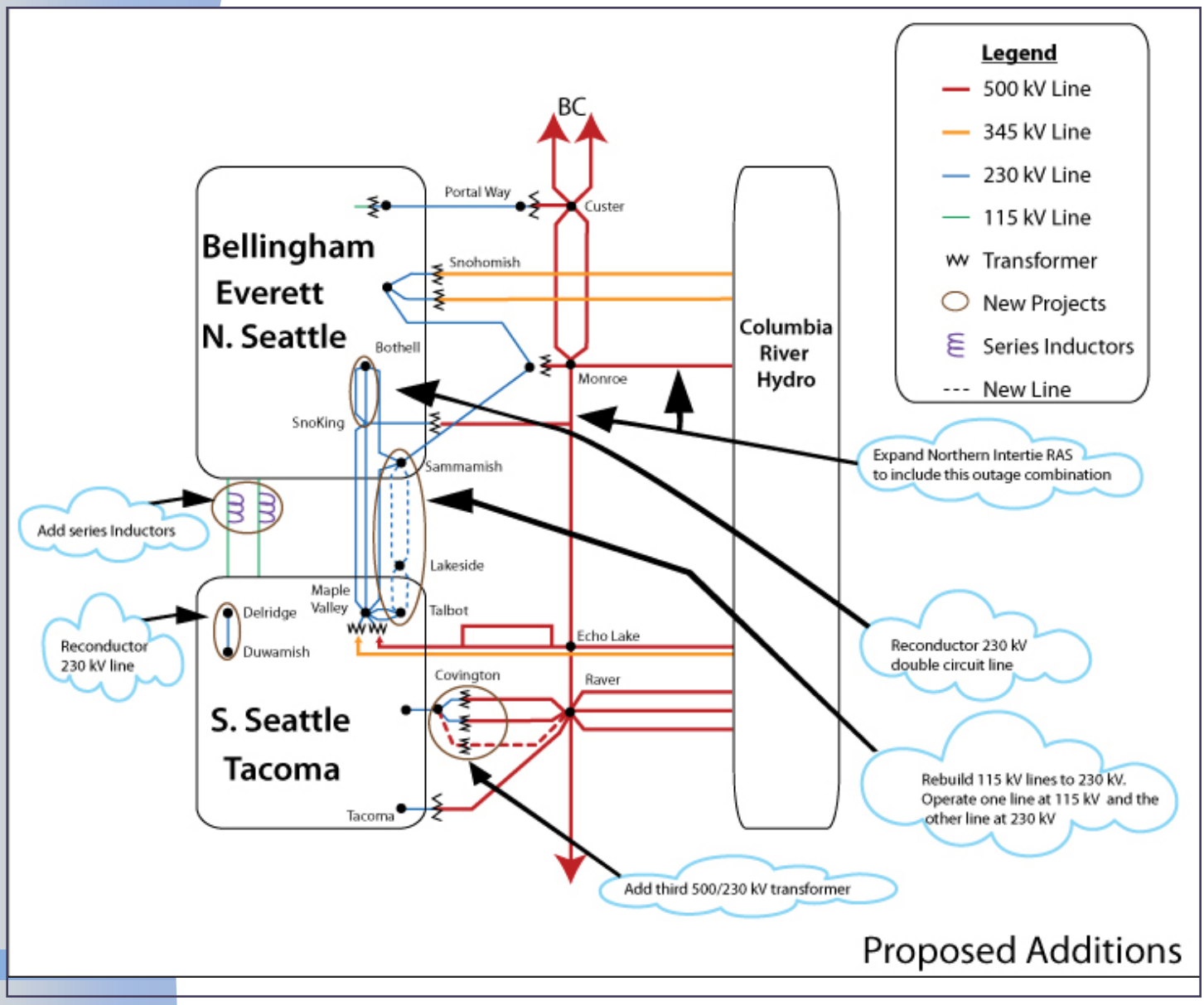


Figure E-1: Puget Sound Area Study Team Proposed Additions

Study Team Reports

The following study teams have been active over the last year:

1. Puget Sound Area Study Team
2. Northern Mid-Columbia Area Study Team
3. Wind Integration Study Team
4. Cross Cascades Study Team
5. Centralia Shutdown Study Team
6. Woodland Study Team

1. Puget Sound Area Study Team

Over the past decade, the transmission owners in the Puget Sound Area have been concerned about the ability of their transmission systems to economically and reliably serve area load while simultaneously supporting power transfer commitments between the Northwest and British Columbia. The primary focus for the Puget Sound Area Study Team has been to address these concerns by developing a long-term transmission expansion plan for the Puget Sound Area.

Planning the transmission system in the Puget Sound Area is a complex undertaking. There are a large number of transmission facilities which means that it is very common in actual system operation to have one or more transmission facilities out of service for scheduled maintenance or for forced outages. As a result, the traditional transmission planning approach of assuming that all facilities are in service may not be reflective of system operation in a system with a large number of transmission lines. To address this concern, the study considered not only system performance following N-1 and N-2 contingencies with all lines in service, but also the system performance with a prior single element out of service. There are many generators in the north Puget Sound Area that affect the transmission capacity and flows in the Puget Sound Area. The study also used historical generation operation to project and model probabilistic generation patterns. The study also included the effects of ambient air temperature variations on thermal facility ratings. The information gathered from studying the system response during pre-contingent outage conditions provided valuable insight into system performance and was used to determine transmission facility additions that would be required to minimize operating actions like curtailing firm transfers or adjusting area generation with an initial facility out of service. In October 2010, the Puget Sound Area Study Team issued a report on these results entitled, "Transmission Expansion Plan for the Puget Sound Area." This plan was updated in October 2011.

After reviewing a large number of potential facility additions, the following seven projects were identified as being the most effective at correcting the major limitations found on the system and significantly reducing the risk of curtailing firm transfers. These facilities are shown in Figure E-1.

- Reconductor the Bothell-SnoKing 230 kV double circuit line.
- Add series inductors to the Broad Street-Massachusetts and Broad Street-East Pine 115 kV underground cables.
- Extend the Northern Intertie Remedial Action Scheme (RAS) for the combined loss of Monroe-SnoKing-Echo Lake and Chief Joseph-Monroe 500 kV lines.
- Add a third Covington 500/230 kV transformer.
- Add a second Portal Way 230/115 kV transformer.
- Rebuild both the Sammamish-Lakeside-Talbot 115 kV lines to 230 kV. Energize one line at 230 kV and the other at 115 kV
- Reconductor the Duwamish - Delridge 230 kV line.

The two transmission problems identified in the 2010 System Assessment, the Seattle downtown 115 kV cables, cable overloads and the Monroe-Novelty 230 kV overloads, have also been addressed in the Puget Sound Area Transmission Expansion Plan. Adding series inductors to the two 115 kV underground cables exiting Broad Street Substation will address the overloading concerns in the Broad Street area. Uprating the Monroe-Novelty 230 kV line will address the overloading concern on this line. The Puget Sound Area Study Team will continue to investigate ways to further reduce the risk of firm curtailments.

Since the release of the original report, the following changes have occurred that have led to the need for the Puget Sound Area

Study Team to revise their transmission plan:

a)Additional scenarios – The Puget Sound area utilities have been meeting regularly since the publication of the original report in October 2010 and have developed several additional scenarios to be studied.

b)Seattle area line rating increases – Several key transmission lines in the region have been rerated to a higher capability. This has enabled the study team to reduce the size of the series inductors (from 26 ohms to 6 ohms) that were proposed for the Seattle City Light 115 kV transmission lines and cables. The smaller inductors lead to more power flowing through the Seattle City Light system resulting in the need to include an additional facility reconductor in the plan; the Duwamish-Delridge 230 kV line.

The Puget Sound Area Study Team reviewed the operating limits (nomograms) developed by Bonneville for the Northern Intertie. In addition to informing all the interested entities about the latest study results, this analysis is useful in giving planners an opportunity to observe general trends on the system. As in the prior year, the studies reviewed this year indicate the general trend of increasing loads in the Puget Sound area leading to a general decrease in transfer capability between the Northwest and Canada.

2. Northern Mid-Columbia Area Study Team

The Northern Mid-Columbia Area Study Team has developed a one-utility plan to resolve the system deficiencies in the greater Wenatchee area. These deficiencies were identified in the 2008 ColumbiaGrid System Assessment and individual utility studies for high generation scenarios during summer conditions. These plans have also been tested during other seasons and with potential wind development in the Central Washington area.

The primary focus area for the Northern Mid-Columbia Study has been the area from Wanapum/Vantage Substation north through Wenatchee to Wells Dam. The region is shown in Figure E -2. The problems in this area are a combination of load growth in the Mid-Columbia area, compounded by the generation from the mid and upper Columbia hydro resources that cause north to south transfers through the area. The problems in this area are most acute in the warm summer season when the capacity of facilities is lowest and local generation is high. Chelan County PUD loads are growing and Alcoa has increased production with an additional pot line served from Valhalla Substation. Douglas County PUD loads are also growing and a new server farm is planned that would add a large new load in the Pangborn Airport area.

The Chelan County PUD and Douglas County PUD systems are electrically in parallel in this area. Several other utilities also have facilities in the area, including: Bonneville, Grant County PUD, Puget Sound Energy and Avista. All of these utilities participated in this study along with Bonneville Power Administration Power Services and the Grand Coulee Project Hydroelectric Authority.

In addition to the existing hydro and wind generation, there is wind generation both under construction and planned in the area. Generation north of Columbia Substation will aggravate the identified issues. Generation south of Columbia Substation will reduce the problems.

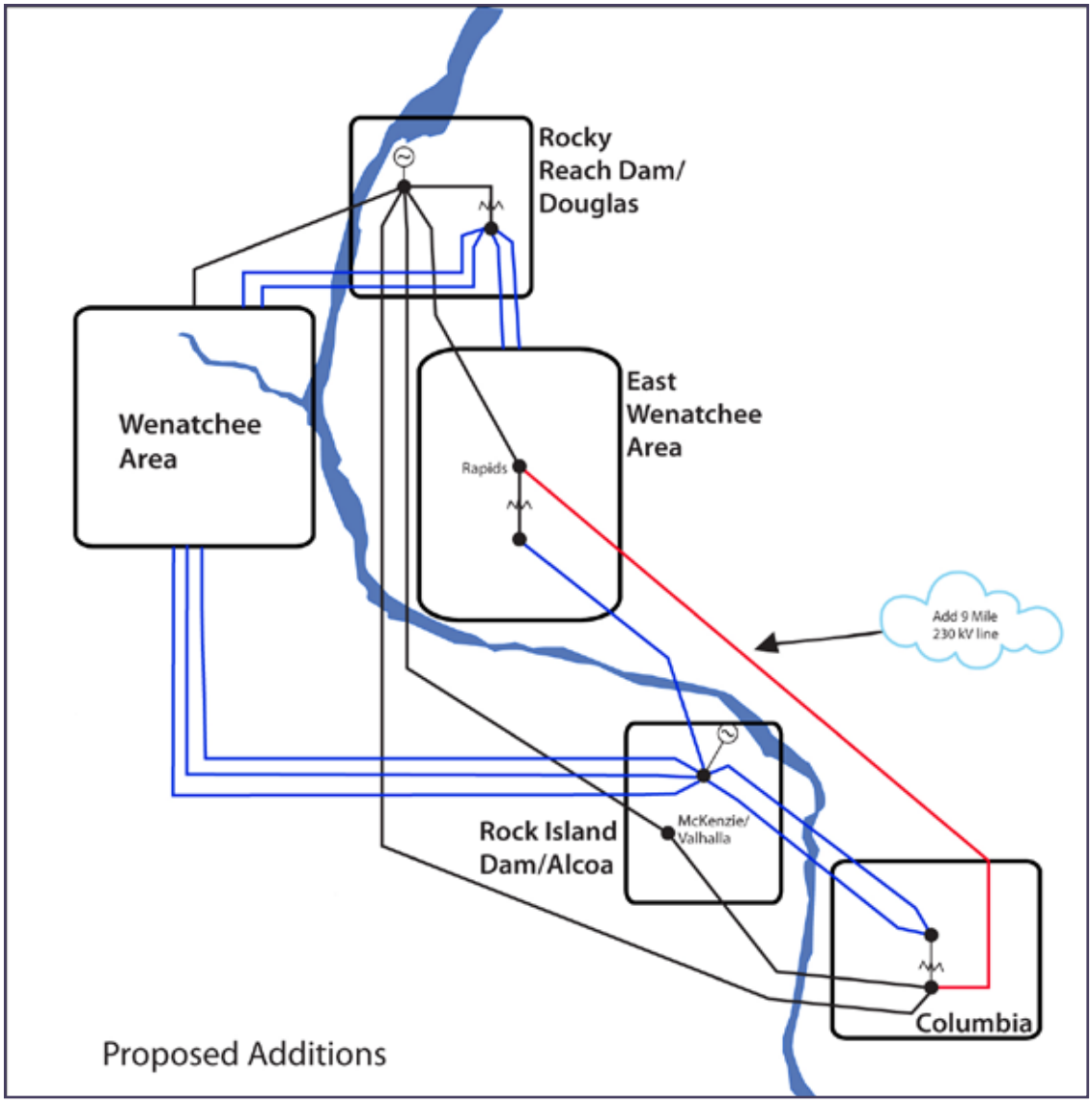


Figure E-2: Northern Mid-Columbia Preferred Plan

To meet the expected load growth in the area, the utilities are planning to add several facilities. Douglas County PUD is planning to build a new 230/115 kV Rapids substation and associated lines in the Pangborn area to support load growth. Chelan County PUD has re-terminated several transmission lines in the Andrew York area in the north end of Wenatchee to improve outage performance. They have also upgraded the capacity of the McKenzie-Wenatchee Tap 115 kV line that feeds the Wenatchee area from the south. Grant County PUD has plans to add a 230 kV line from Columbia Substation, south of Wenatchee, to a substation called Larson in the Moses Lake area. While these projects solve the individual utility's specific problems, there are remaining system problems and impacts in the area that require mitigation.

Seven alternative plans were developed by the study team to resolve the remaining transmission issues in the area. These alternatives included new 230 kV lines, new 115 kV lines, upgrades of existing lines and combinations of the above. Outages required by the Reliability Standards were run for these alternatives, cost estimates

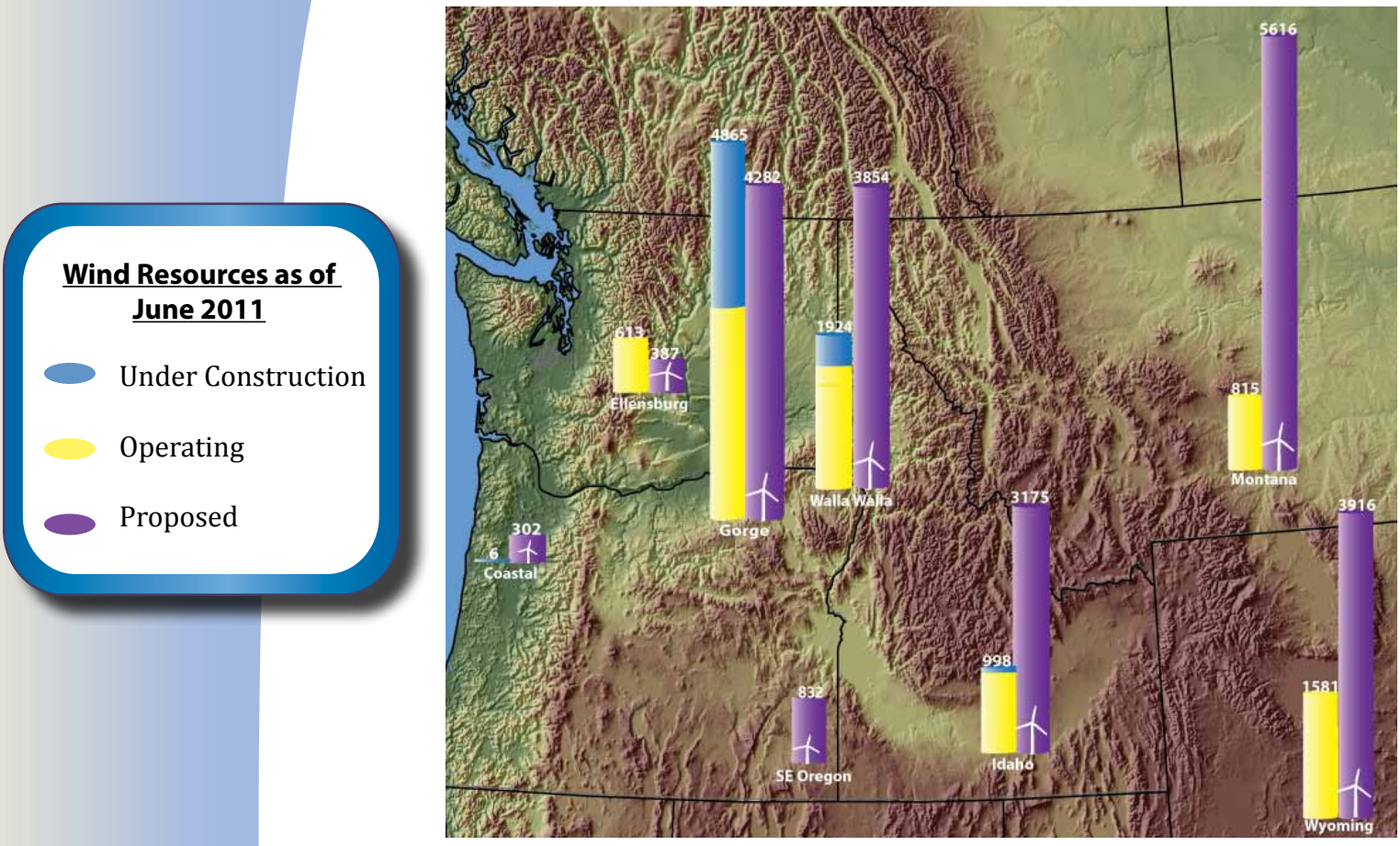


Figure E-3: Wind Resources

were developed and several sensitivity studies were performed. These results were summarized in the ColumbiaGrid Northern Mid-Columbia Study and the study team agreed that the plan to build a Rapids-Columbia 230 kV line would be the best single utility plan for the area.

Although the Study Team has agreed on the best plan for the area, the construction, ownership and cost responsibility of these additional facilities has not been determined at this time. The utilities have been working together to resolve these issues.

3. Wind Integration Study Team

The Northern Tier Transmission Group (NTTG) and ColumbiaGrid formed the Wind Integration Study Team (WIST) to facilitate the integration of Renewable Generation into the northwest transmission grid. Substantial growth of wind generation development has occurred in recent years and may continue. A summary of the existing and future wind resources by state is shown in Figure E-3. The current focus of the group is to support the technical study needs of existing sub-regional and regional initiatives by addressing the following two issues:

•Technical evaluation of system constraints on the increased use of dynamic scheduling – One of the primary products of the WestConnect/NTTG/ColumbiaGrid Joint Initiative (http://www.columbiagrid.org/ji-nttg-wc-overview.cfm) is the increased utilization of dynamic scheduling. However, there are technical constraints on the various scheduling paths that limit the acceptable

magnitude or rate of these schedule changes. This issue was highlighted on the Northern Intertie where it was determined that voltage support issues limited the amount of dynamic schedules that could be accommodated.

•Action Items from the Northwest Wind Integration Action Plan – The WIST is addressing the following two action items from the Northwest Wind Integration Action Plan: 1) the development of a transmission planning methodology that seeks a balance between the cost of transmission capacity and the value of delivered wind energy; and, 2) apply this new transmission planning methodology to regional transmission planning.

The Action Items from the Northwest Wind Integration Action Plan were addressed in studies in 2010 that culminated in a report entitled, "Relative Northwest Benefits of Local vs. Remote Wind Generation". This report was approved by the WIST in early 2011 and is posted on the ColumbiaGrid website.

In 2010, a dynamic transfer capability study by BPA was presented and reviewed by WIST. This type of analysis was expanded by WIST in October 2010 to study the dynamic transfer capability of other paths. In 2011, this Dynamic Transfer Capability Task Force produced Phase 1 and Phase 2 reports confirming the need for dynamic transfer capability limits and exploring dynamic transfer capability study methodologies. A Phase 3 study was completed in 2011 to apply this methodology to several NW paths. These efforts are being closely coordinated with other sub-regional groups and WECC.

4. Cross Cascades North Study Team

The 2009, 2010, and 2011 System Assessments identified outages associated with the West of Cascades North path as a possible concern in the ten-year winter studies. The location of this path is shown in Figure E-4. This path delivers remote resources from east of the Cascade Mountains to the west side Puget Sound load areas. If critical outages on this path were to occur during winter cold snaps in the latter part of the planning horizon with westside generation off, voltage stability limitations could result. A long construction lead time would be required if a new line is needed to mitigate the limit, so the study team was formed in 2010.

The West of Cascades North path consists of the Chief Joe-Monroe, Schultz-Raver #1,

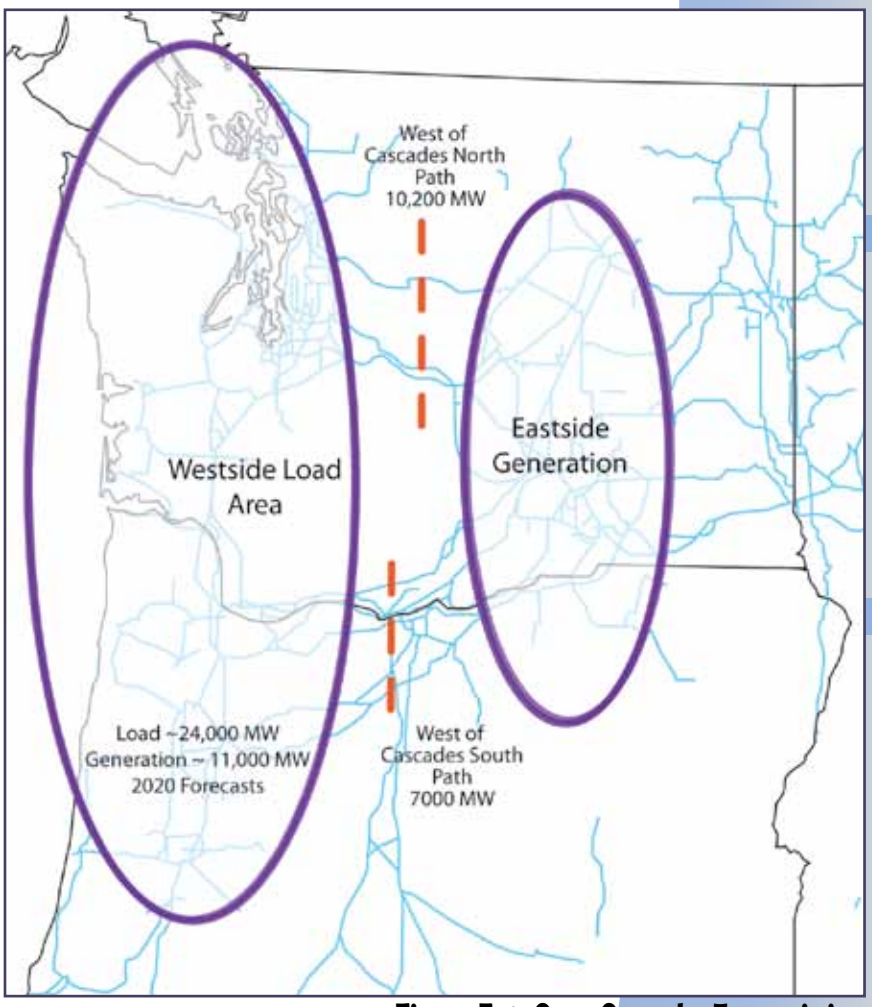


Figure E-4: Cross Cascades Transmission

#3 and #4 and the Schultz-Echo Lake 500 kV lines; the Chief Joe-Snohomish #3 and #4 and Rocky Reach-Maple Valley 345 kV lines; the Coulee-Olympia 300 kV line; and the Rocky Reach-White River and Columbia-Covington 230 kV (now Bettas Road-Covington) lines. The transfer limit of this path is approximately 10,000 MW due to voltage stability limits in the Puget Sound area.

This path typically loads most heavily during abnormally cold weather events. The path is usually loaded well below the limit for the rest of the time (refer to path loading diagram Figures I-3 and I-4). The most recent cold weather event occurred in December 2008. With the increasing remote renewable generation in the planning models potentially displacing westside thermal generation, the heavy path flow could occur during normal winter weather.

To work toward resolving these issues, a ColumbiaGrid Cross Cascades Study Team was formed with ColumbiaGrid participants and other interested parties. The purpose of this study team is to calculate the incremental path limit increases that various alternative projects could provide. The calculation methods include both load growth and westside generation displacement, including the permanent closure of the Centralia generation station. A final report is scheduled for February 2012.

5. Centralia Shutdown Study Team

The Centralia Power Plant is located in Centralia, Washington and includes two identical coal-fired generating units with a combined net capacity of about 1400 MW. There is also gas-fired generation located at this site; however, the closure discussed in this study is limited to the coal portion of the

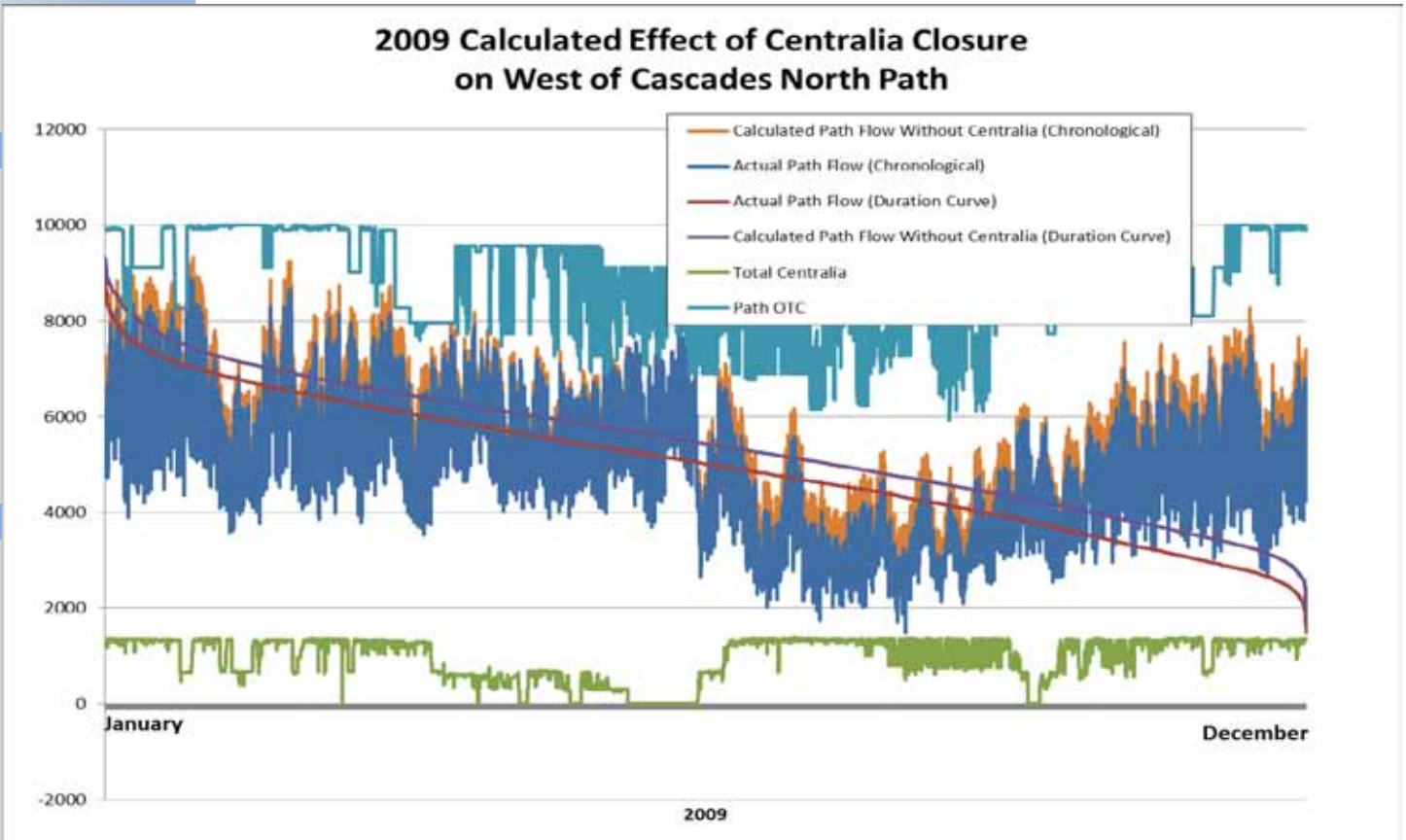


Figure E-5: 2009 Calculated Effect of Centralia Closure on West of Cascades North Path

power plant. Senate Bill 5769 solidifies into law a collaborative agreement with the state of Washington and the owner of the Centralia Power Plant (Alberta-based TransAlta) to close the state's two coal-fired boilers – the first in 2020 and the second in 2025.

One issue that surfaced in association with the closure is the effect that it would have on the transmission grid, including transmission plans for the area. To address this issue, ColumbiaGrid initiated a study examining the effect of the closure of one and two units at Centralia. The potential plans for mitigation discussed in the Centralia closure study are focused on the effect of the closure of the first unit which is within the ten-year planning horizon typically used in transmission system planning. The impact of the closure of the second unit would be similar to the first and its impact would be cumulative.

The study results identified the following technical issues associated with the planned closure of the Centralia Power Plant. Whether or not these issues will be a concern depends largely on the location of the replacement generation for Centralia. If the replacement generation is located to the east and remote from Centralia, new transmission lines will be needed to enable the new power flows that will be required to replace the power injected locally by Centralia.

a) Increased Loading on the Cross Cascades Transmission Paths – During high levels of power transfers from the east side of the Cascades, the West of Cascades North and West of Cascades South transmission paths may experience heavy loading. While the capability on these paths would not be significantly affected by the closure of Centralia, the usage of the paths would increase substantially if the replacement generation comes from the east side of the Cascades. The most limiting of these paths is the West of Cascades North Path. Therefore, it will be the path that requires reinforcement first.

The potential effect of a closure of Centralia on the loading on this path is shown in Figure E–5. The effect of the closure of one unit at Centralia could increase loading on this path by approximately 300 MW and accelerate the need to reinforce this path which is expected to be a costly undertaking. A new 500 kV transmission line could be required which would add roughly between 800 MW and 1600 MW of transmission capability to

the West of Cascades North path at a cost of roughly one billion dollars. As a result, if it is assumed that the new line would add 1200 MW of new capability, the 300 MW impact on this interface can be roughly valued at $250 million. Clearly this is a significant impact. The impact could be mitigated through operating thermal generation on the west side of the Cascades above current levels or adding new generation. However, requiring the shifting of generation from east of the Cascades to the west side could be costly and may result in curtailing the operation of renewable replacement generation such as wind generators. This may hinder the fulfillment of renewable energy requirements.

b) Portland Area Facility Loading – The closure of the Centralia Power Plant could increase the potential for transmission system overloading on 230 kV and lower voltage facilities in the Portland load area. High south-to-north flows occur during periods of low west-side gas-fired generation, low Upper Columbia hydro generation, and high transfers to British Columbia. These conditions would be most likely to occur during light load system conditions. This is not expected to be a peak load period concern as some west-side gas-fired generation would most likely be operating during peak load periods and this would off-load the transmission facilities of concern.

This study determined that if the I-5 Corridor Reinforcement project moves forward as planned, these transmission issues will be sufficiently mitigated to offset the potential closure of both Centralia units. If the I-5 Corridor Reinforcement Project does not move forward, then alternative facility reinforcements, the addition of new west side generation, or additional constraints on the operation of the transmission system will be necessary (i.e., curtailments or the need to run specific generators to off-load specific transmission facilities). The redispatch of thermal generation under light load conditions would likely be an out-of-market operation which can be costly and may result in the curtailment of renewable generation.

c) Tacoma/Olympia Area Facility Loading - In addition to the above concerns, at the onset of this study, it appeared that the closure of the Centralia Power Plant would increase the potential for overloading in the Tacoma/Olympia area (Raver-Paul transmission corridor). The potential overloading is most likely to occur during periods of high transfers from British Columbia and the Northwest to California such as typically occurs during the spring and summer periods. Generation from the Centralia Power Plant helps to off-load this path. However, after an examination of recent historical data, the study concluded that historically Centralia generation has been out of service during the period of concern, presumably for maintenance, and, as a result, the Centralia Power Plant cannot be relied upon to address this potential overloading. In other words, any mitigation that is necessary to address concerns with potential overloading in the Raver-Paul corridor will be necessary whether or not the Centralia Power Plant continues to operate. However, it should be noted that in the future, with additional renewable generation integrated into the grid, the Raver-Paul transmission limitation may be a concern over a larger period of the year. If this trend occurs, then generation at Centralia and further south could be dispatched to mitigate the Raver-Paul transmission concerns or

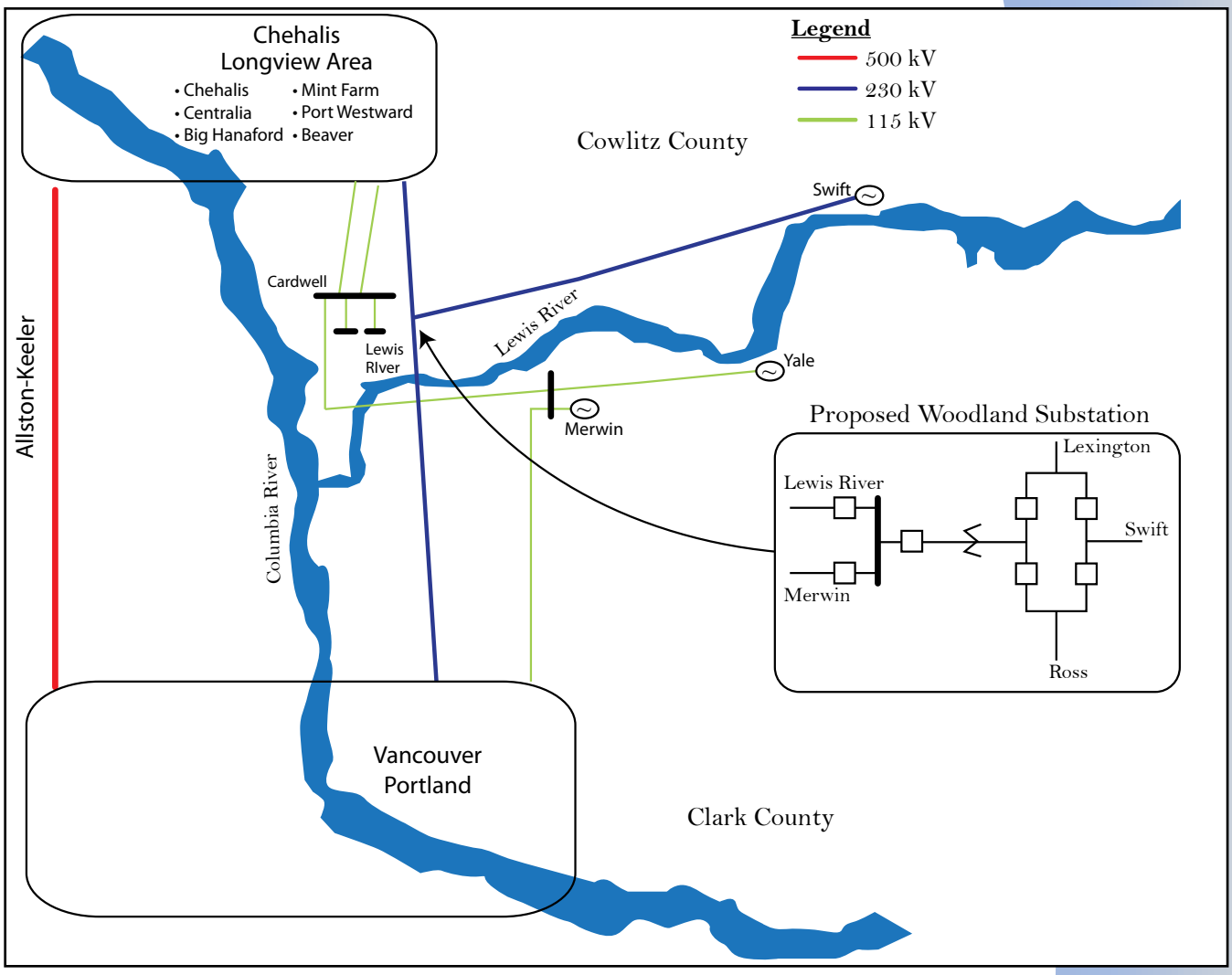


Figure E-6: Woodland Study Map

they could be mitigated by transmission reinforcement.

6. Woodland Transformer Study:

Cowlitz County PUD has a long term need to support loads in the southern part of their system around the Lewis River area. They have worked with Bonneville on a preliminary study of the impacts of a 230/115 kV transformer at Woodland. There is much generation in the area and to the north that impact local transmission flows. The Allston-Keeler line is in parallel with this system which can also have an impact on local flows (expansion of this area with the I-5 Corridor project will also cause impacts). Also Clark County PUD and PacifiCorp have facilities in this area and could be impacted and/or benefit from the Woodland project. There is also a proposed generation project at Kalama (345 MW gas combustion turbine) that could impact the transmission system performance and sensitivity studies are proposed to analyze its impact. Cowlitz has asked ColumbiaGrid to perform a regional assessment of this transformer addition along with other possible upgrade options. ColumbiaGrid will perform a study of this project with Cowlitz and other impacted utilities over the next several months.

Figure E-6 shows a map of the affected area of the Woodland Transformer Study.

Sensitivity Studies for 2011

The following sensitivities that were proposed for analysis in 2011 are addressed below:

1. Further study of voltage stability issues and unsolved outages from the System Assessment: The unsolved outages listed in Attachment C of the 2011 System Assessment (CEII protected) required further investigation to determine the cause and mitigation of the failed solutions. These outages involve several areas of the system:

- Port Angeles area
- Shelton area
- Centralia area
- Santiam Area
- Fairview area on the southern Oregon Coast
- Grants Pass area
- Redmond-Bend area
- Northern California area (Alturas)
- Kalispell area
- Wenatchee area (McKenzie)
- Columbia Gorge area.

The 2011 System Assessment contingency analysis had 21 contingencies that failed to solve in the ten-year winter case. The five-year winter case had 18 contingencies that failed to solve. The ten-year summer case had eight failed solutions. The five-year summer case had 12 failed solutions. Failed solutions are often caused by the modeled conditions exceeding voltage stability or angular stability solution limits.

The 2011 System Assessment applied the WECC post transient power flow solution methodology, which eliminated simulation of manual and slow automatic actions. An effective screening technique to determine whether load levels might exceed the voltage stability limit is to set the voltage threshold for voltage sensitive loads to a high level, such as 0.90 per unit voltage. During the power flow solution iterations, if the voltage at a load is below 0.90 per unit, the load is not constant power and it decreases. The decrease is nonlinear to facilitate the solution.

With successful power flow solutions for these outages, potential mitigation was developed that could mitigate the voltage stability issues in these areas. This mitigation includes:

- Adding an SVC in the Port Angeles area (110 Mvars).

•Adding an SVC in the Grants Pass area (200 Mvars).
•Adding an SVC in the Harney area (20 Mvars).
•Adding a second Ponderosa 500/230 kV transformer which is now included in the committed Ten Year Plan.
•Adding an SVC in the Alturas area (50 Mvars).
•Additional load tripping in the Fairmount area (100 MW).
•Additional load tripping in the Columbia Falls/Kalispell area (80 MW).
•Transfer trip (no fault) for inadvertent breaker opening at Santiam on the Toledo 230 kV line.
•Automated load tripping for the loss of the Rocky Reach 115 kV station bus.
•Switch in existing shunt devices near wind plants in the Columbia Gorge.
•Rebuilding one Shelton-Fairmont 115 kV line to double-circuit 230 kV. (This was tested in the 2011 Biennial Transmission Expansion Plan).

The Fairview area problems may be a modeling issue that will be pursued in the 2012 System Assessment.

More information on this analysis can be found at http://www.columbiagrid.org/basecases-results-overview.cfm.

2. Five Year Light Load Case: The light load case used for the Centralia closure study that was completed in April uncovered some new transmission constraints in the Portland area for a modified generation pattern even with the existing Centralia generation on. Since this was not the focus of the Centralia study, this issue was explored in a sensitivity study for the Biennial Plan. This sensitivity was run from the same base case with Centralia in service and the normal system assessment outage list. It also explored the issues that were uncovered in the Centralia study in more detail. The study results are summarized below.

The WECC approved 16LA1-S case was used in the ColumbiaGrid 2010 System Assessment Light Load Sensitivity Study. The generation/interchange pattern modeled did not result in new contingency violations when compared with the peak summer and peak winter system assessments.

In early 2011, the ColumbiaGrid Centralia Closure Study used the same 16LA1-S case with substantial modifications to explore a variety of generation patterns. The study was focused on comparing contingency analysis results before and after the Centralia closure, so issues not impacted by Centralia were filtered out of the analysis. One of those studied generation patterns that identified new issues beyond the impact of Centralia was high wind generation simultaneous with low gas generation.

The Northwest hydro generation was kept at the levels in the approved 16LA1-S case. All gas generation except for March Point was turned off. Centralia and the Columbia Generating Station remained on. All wind generation in the model was turned on at maximum. The power export to Canada was modified to 1500 MW (it was reduced from 2000 MW). The generation deficit to serve the Northwest load after these modifications was served by importing on the COI (961 MW) and the PDCI (1376 MW).

After the generation/interchange modifications were made for this sensitivity study, there were two Category A (no

	2016 Peak Winter Case	2016 Peak Summer Case
Facilities 230 kV and above with overloads over 105% without existing mitigation	19	29
Total number of N-1-1 outages that overload these facilities	2858	4395
Unsolved Outages not mitigated by RAS or redispatch	3	7

Table F1: Results from N-1-1 Outage Sensitivity

outage) overloads primarily due to the wind generation at Jones Canyon and Hopkins Ridge. Review of the latest BPA data submittals to the Area Coordinator showed some branch ratings in 16LA1-S were obsolete. After applying the updated parameters to those branches, and the local RAS, these Category A overloads were eliminated.

Results Summary

New problems that were not identified in earlier studies include:

a. 115 kV Category A violation: The Benton-Taunton 115 kV line overloads (113%) and the Taunton-South Othello Tap 115 kV overloads (106%) in the base case without outages. This line overload showed up in the summer peak and winter peak system assessment study conditions, but under outage conditions. Avista has committed plans to upgrade this line.

b. 230 kV Category B violation: The Murrayhill-St Marys 230 kV line overloads (135%) for the N-1 Keeler-Pearl 500 kV outage. This was previously discovered in the Centralia study. The overload does not occur if generation at River Road, Beaver, Port Westward, and Mint Farm is in-service.

c. 230 kV Category B violation: The Big Eddy-Parkdale-Troutdale 230 kV line overloads (104%) for the N-1 Big Eddy-Ostrander 500 kV outage even with the planned line upgrade to 100 degrees Celsius by the fall of 2012. The overload will not occur if the generation to prevent the Murrayhill-St Marys 230 kV line overload is in-service.

d. 230kV Category B violation: The McNary bus tie between bus sections 2 and 3 overloads (116%) for the McNary 500/230 kV transformer outage and several Category C breaker failures. These outages included modeling of the Jones Canyon RAS (Leaning Juniper only). Redispatch could relieve these overloads.

e. 230 kV Category C violation: The McLoughlin-Pearl 230 kV line section overloads (150%) for the N-2 Pearl-Ostrander Pearl-Marion 500 kV outage. This was previously discovered in the Centralia study. The overload doesn't occur if generation at River Road, Beaver, Port Westward, Mint Farm, and Chehalis is in-service. The newly revised but unapproved WECC Reliability Criteria would remove this line from the N-2 adjacent circuit requirement.

f. 230 kV Category C violation: The Columbia-Vantage 230 kV line overloads (128%) and the Wanapum-Ancient Lakes Tap 230 kV line section overloads (124%) for the N-2 Schultz-Wautoma/Schultz-Vantage 500 kV outage. The power flow on these

lines is affected by the hydro generation pattern at Coulee and the mid-Columbia hydro projects. Redispatch could relieve these overloads.

More information on this analysis can be found at http://www.columbiagrid.org/basecases-results-overview.cfm.

3. Ten-Year Winter Case: Since a recent ten-year winter base case was not available this spring, a seven-year high wind winter peak load base case was run. A ten-year case was expected to be available in September to run with the same outages in the 2011 System Assessment. The WECC Ten-Year winter case has been delayed so that it will not be possible to complete this study for the Biennial Plan Update. Analysis of this winter case will be included in the 2012 System Assessment.

4. N-1-1 500 kV Outage Sensitivity: To help meet the requirements of the NERC and WECC Planning Standards, PSE suggested that a sensitivity study be completed looking at all the combinations of N-1-1 outages of 500 kV equipment (lines and transformers). These studies were completed by taking out one 500 kV facility, then running all the remaining N-1 500 and 230 kV outages. This was repeated by starting over with the original base case and taking the next 500 kV element out, then running all the remaining 500 and 230 kV equipment outages; this process was continued until all possible N-1-1 outages were studied. Problem outages were identified and potential mitigation was proposed for significant outages. Utilities then reviewed the analysis and decided whether mitigation is appropriate (mitigation is not required by NERC and WECC Planning Standards). The over 165,000 outage combinations were run on the five year winter and summer peak load cases and the results are shown in Table F1.

The analysis resulted in 48 facilities at 230 kV and above with overloads above 105%. Nineteen of these facility overloads involve multiple ColumbiaGrid participants and occur mainly in the Puget Sound, Olympic Peninsula, Wenatchee, and Portland areas. Many of the issues identified in this study are load service related. Previous study work has identified some of these overloads and suggested projects to prevent them. In the Puget Sound area, a third 500/230 kV Covington transformer project and extending the Northern Intertie RAS for the combined outage of the Monroe – SnoKing – Echo Lake and Chief Joseph - Monroe lines were recommended by the Puget Sound Area Study Team to prevent the identified N-1-1 overloads. The overloads seen in the Wenatchee area would be prevented with the Columbia-Rapids 230 kV line project that has been recommended by the Mid-Columbia Study Team. A few of the issues will require further study.

The majority of overloads that do not involve ColumbiaGrid participants occur in the Klamath Falls, Dixonville, and Grants Pass areas.

The analysis also resulted in ten failed solutions that would not be mitigated by existing RAS on the transmission system or by redispatching system resources after the initial 500 kV outage had occurred. All of these failed solutions were a result of low system voltages in the areas of the outage combination: two in the Santiam area in the 2016 winter case, four in the Alturas area in the 2016 summer case, and the remaining four in the Grants

Pass area (one in the 2016 winter case and three in the 2016 summer case). These areas also experienced unsolved outages in the normal system assessment (see Sensitivity #1 in the Sensitivity Studies section of this report).

More information on this analysis can be found at http://www.columbiagrid.org/basecases-results-overview.cfm.

5. Custer Ring Bus Modeling: Outages that involve the 230 kV ring bus at Custer were redefined in the System Assessment. As an example, the N-2 Custer–Sedro–Murray/Custer–Bellingham contingency was not represented correctly in the earlier System Assessment. This contingency will actually split the Custer 230 kV bus and isolate each of the Custer 500/230 kV transformers with one of the Intalco lines. The original outage did not split the bus. The effect of this modeling change is to increase the overall impedance for power flow through the Portal Way transformer so more flow stays on the Custer-Monroe 500 kV lines during outages. The studies with the corrected model were performed on the ten-year heavy summer base case with north to south flows on the Northern Intertie.

The impedance change showed only minor flow changes on the Custer-Monroe 500 kV lines and these flow changes did not result in any new system limitations. This modeling change did show a significant change in flow on the 500/230 kV transformers at Custer but not enough to create a limitation. Future assessments will use this new model for Custer 230 kV N-2 contingencies.

More information on this analysis can be found at http://www.columbiagrid.org/basecases-results-overview.cfm.

6. Natural Gas Limitations resulting from an Extended Winter Peak Load Event: Natural gas supply infrastructure in the I-5 corridor is designed to meet electric utility loads during moderate to severe cold weather events. A significant amount of existing natural gas-fired generating capacity in the I-5 corridor does not have contracts for firm natural gas supplies. If there is an early or extended winter peak load event or if a second winter peak load event occurs and reduces the gas storage system, non-firm gas supplies may be unavailable and the resulting lack of local gas generation could impact transmission system performance. Information has been collected on the issues associated with gas supply and a list of industry contacts has been developed. Given the significant scope of this study, it was elevated from a sensitivity study to an independent study with its own study team. The study team effort is to be initiated in early 2012 with the study report planned to be completed by the end of 2012.

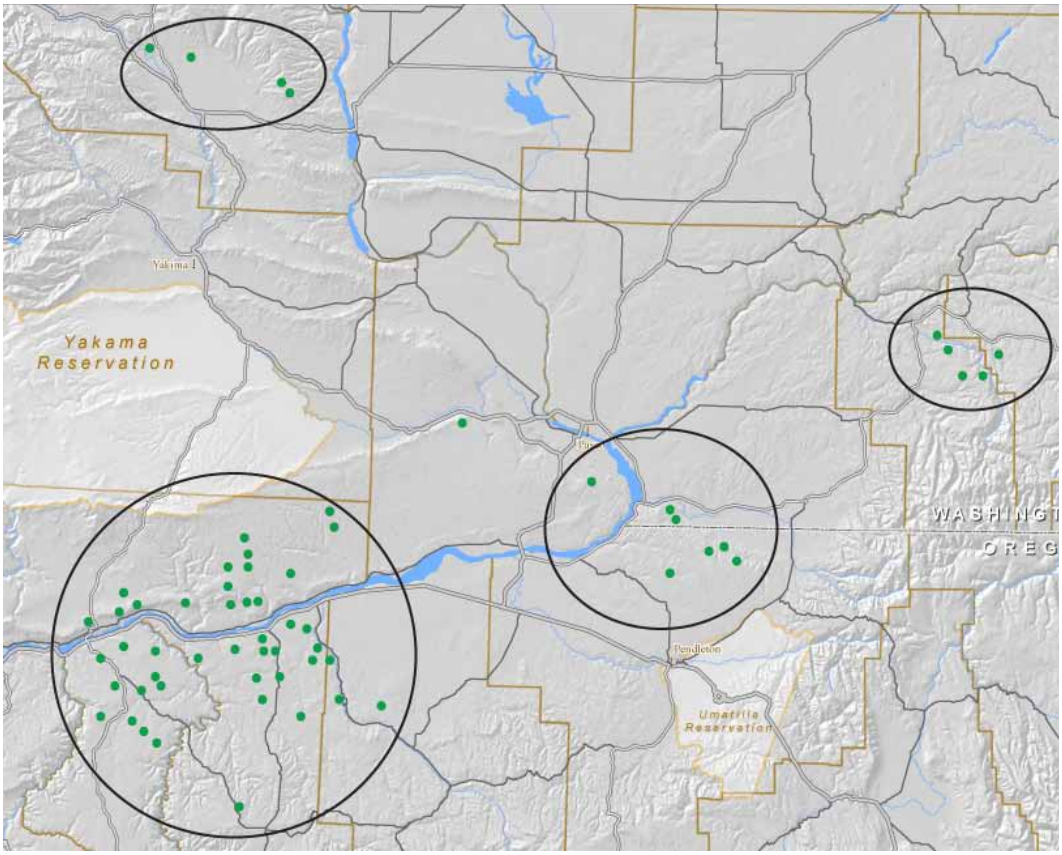


Figure F1: Wind Clusters

7. Wind Sensitivity Studies: Most wind integration studies look at extreme conditions with all wind generation on in an area to ensure the reliability of the bulk transmission system. However, areas with high wind generation could experience localized transmission system problems as wind generation picks up and drops off daily or as fronts move through the area. This sensitivity is intended to investigate patterns of generation that have occurred using actual wind generation on the new ten-year light summer WECC base case that was to be available in late summer (22LS1-S).

This WECC Ten-Year light summer case has been delayed so that it was not possible to complete this study for the Expansion Plan Update. Analysis of this case will be done at a later time. The strategy for this study is as follows.

The northwest wind generation can be divided into four separate geographic areas (Figure F-1):

a. Gorge: A large area of wind development that starts around Highway 97 as it crosses the Columbia River and east to the Hermiston/Interstate-82 area.
b. Southeast Washington: East of Interstate-82 and west of Walla Walla.
c. Snake River: East of Lower Monumental Dam along the Snake River in Eastern Washington.
d. Ellensburg Washington area.

Actual wind data from these project areas is not available at this time at the project level to determine patterns for study. But the wind projects in the Gorge and southeast

Washington are located in a similar wind shed with diurnal wind changes normally occurring in the west to east direction, i.e. the wind starts picking up in the west and continues toward the east. To test if these wind patterns might cause local transmission problems, the following wind area combinations will be studied: 1) Gorge wind only; 2) Gorge and Southeast Washington wind; 3) Gorge, Southeast Washington and Snake River wind; 4) Southeast Washington and Snake River wind; 5) Snake River wind only. These five scenarios should cover the possible daily wind patterns as wind picks up and drops off in the region. The normal outage list used in the System Assessment will be reduced to cover local outages only and will be applied to each of these wind scenarios. Redispatch of generation to accommodate the wind generation will take place using westside gas resources to show anticipated worst case patterns. Local transmission overloads will be identified for each wind pattern. This work will be reported in a separate report or within the 2012 System Assessment. For this initial study, the Ellensburg area wind will not be included as it is not anticipated to cause any problems due to the smaller size and distance from the other areas. It may be pursued in the future.

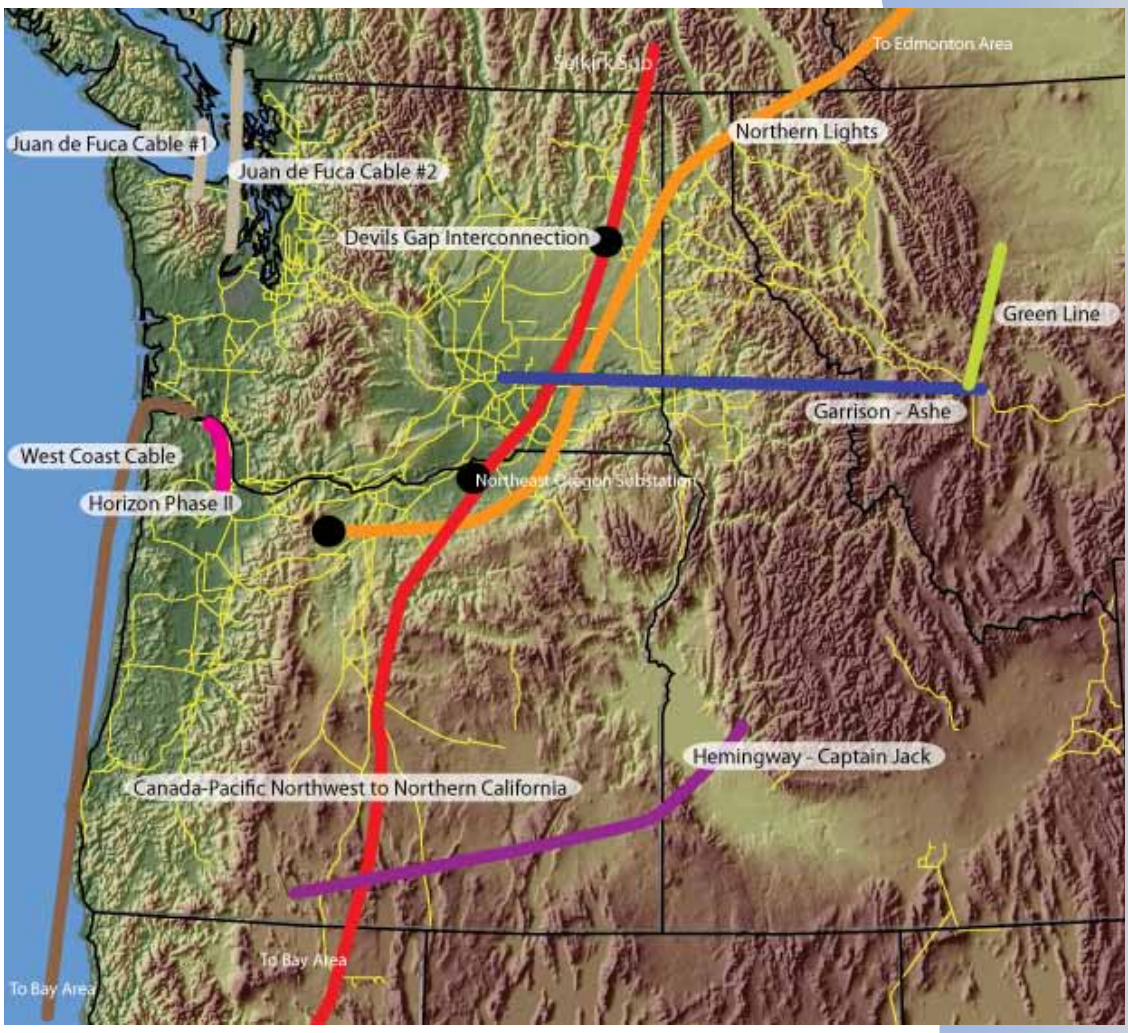


Figure G-1: Other Potential Transmission Projects

Potential Major Transmission Projects

Several large transmission projects have been proposed in the region to integrate new resources and accommodate economy transfers to access lower cost resources. See Figure G-1 for a map of these projects. Some are being proposed by ColumbiaGrid members. All of the projects are electrically in parallel with ColumbiaGrid member facilities and could have impacts to the existing system. Many of them are in the WECC Path Rating Process. This list is smaller than previous reports since several of the projects listed have moved into the committed project list.

At this point, none of these projects have firm commitments for project construction from their sponsors. Only projects with firm commitments were included in the assessment cases. This approach avoids masking problems on the transmission systems that would need to be addressed if the more speculative projects are not built. Analysis of impacts that these major projects might have on the load service and firm transmission service commitments of the PEFA parties will be addressed later by the appropriate ColumbiaGrid study teams.

1. Horizon Phase II Project

The Portland General Electric Horizon Phase II Project consists of a new 37-mile 230 kV transmission line from the existing PGE Trojan

and Horizon substations and a second 230/115 kV bulk power transformer at the existing Horizon Substation. This project is the result of a merchant request and will provide the capacity needed to integrate a proposed 200 MW generation project next to the existing Port Westward plant. The target energization date for this project is December 2017. The project is contingent upon the generation addition, and is currently on hold pending the outcome of the merchant request.

2. Garrison-Ashe Project

The 2010 BPA Network Open Season included several requests that could not be accommodated by the Colstrip Upgrade Project. To gain additional capacity to fulfill these requests, a 430 mile series compensated Garrison-Ashe 500 kV line was studied with an intermediate station between Taft and Hot Springs. The earliest energization date for this project is 2018 and no WECC Regional Planning or Rating studies have been started. Due to the high cost of this project, BPA has not made any commitment to pursue this project.

3. Canada-Pacific Northwest to Northern California Project

The Canada-Pacific Northwest-California (CNC) Project was a 1000 mile transmission line from British Columbia to northern California sponsored by Avista, BC Hydro and Pacific Gas and Electric. The plan of service involved a 500 kV AC transmission line from Selkirk Substation to Devils Gap Substation to NEO (Northeast Oregon) Substation (Northern Segment) and a +500 kV DC transmission line from NEO Substation to the San Francisco Bay Area (Southern Segment). The project achieved Phase 2 of the WECC rating process with a Planned Rating of 3000 MW in the north-to-south direction.

During 2010, the Project Sponsors analyzed a scaled down, 2000 MW version of the project as their needs for renewable generation have changed. A New Transmission Feasibility Assessment report was completed in April 2011 and is available on the ColumbiaGrid website.

At a meeting in June 2011, principals from each of the utilities involved in the 2010 analysis met to discuss the commercial viability of, and their interest in continuing to support development of, a major new brown field transmission project. They also discussed holding an "open season" to assess the commercial and economic interest in upgrading the north-south 500 kV system in Oregon and northern California. The parties decided to defer an open season and the CNC Project Sponsors decided to end all further development work on the CNC Project. The Pacific Intertie owners intend to meet again in early 2012 to determine if an open season should proceed in light of any new information.

PG&E filed an October 2011 request with FERC to recover approximately $8.4 million in abandonment costs associated with its efforts on the Project.

4. Northern Lights Project

The Northern Lights project is a 970-mile high-voltage DC line (+/- 500 kV) beginning at Edmonton, Alberta and ending at a new substation near the existing Buckley Substation in north central Oregon. At least one intermediate terminal is planned in a location south of Calgary, near Alberta's

largest wind development region. The project is planned to have bi-directional capacity as high as 3,000 MW. This project takes advantage of the diversities in load and generation between the two areas. The project is currently on hold.

5. Juan de Fuca Cable #1 Project

Sea Breeze Pacific is proposing an underwater 550 MW high-voltage DC +/-150 kV cable across the Strait of Juan de Fuca from Pike Substation near Victoria on Vancouver Island Canada to the Port Angeles Substation in Port Angeles, Washington. This project rating is planned to be fully controllable and bi-directional. According to the Bonneville and BC Hydro interconnection studies completed to date, the project will also require existing system reinforcements, including 230 kV line upgrades from Satsop to Port Angeles Substations. This project was granted Phase 2 rating status on June 29, 2007.

6. Juan de Fuca Cable #2 Project

Sea Breeze Pacific is proposing a Multi-terminal underwater 1,100 MW high-voltage DC cable (+/- 300 kV) across the Strait of Juan de Fuca from Ingledow Substation near Vancouver, British Columbia, Canada to Pike Substation near Victoria on Vancouver Island Canada, to either the Shelton or Olympia Substations on the Olympic Peninsula, Washington. The 1100 MW project rating is planned to be fully controllable and bi-directional.

7. West Coast Cable Project

Sea Breeze Pacific is proposing an underwater high-voltage DC cable from Allston Substation in northwest Oregon near Rainier to the San Francisco Bay area. This project has a planned rating of 1,600 MW. This project is intended to bring renewable resources from the Northwest to California.

8. Green Line

In conjunction with the MATL project, Enbridge is proposing the Green Line Project to provide access to the Mid-Columbia Hub. This project is a 100 mile extension of the MATL project to connect to the Colstrip Transmission system at Garrison or Townsend. This project is expected to provide up to 1000 MW Capacity and is in the feasibility stage.

9. Hemingway-Captain Jack

PacifiCorp had proposed to build a new 375-mile 500 kV line from Hemingway Substation in the Boise area to Captain Jack Substation in southern Oregon. This project has since been dropped from PacifiCorp's Ten Year Plan but remains as a conceptual plan to meet future needs.

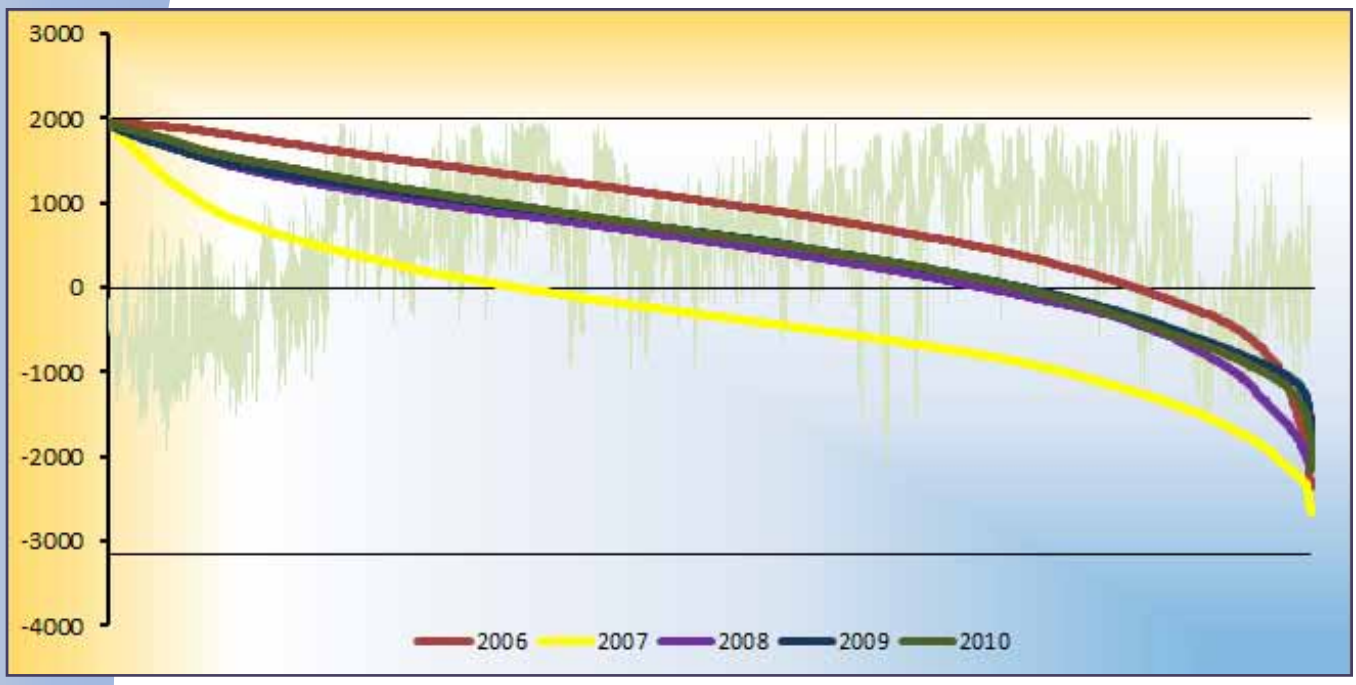


Figure H1: Northwest to British Columbia

Interfaces with Neighboring Regions

Oregon and Washington are electrically interconnected to Canada, Montana, Idaho, Nevada, and California. The historical use of these interconnections has been high and of benefit to the Northwest and others. Transmission service requests submitted to transmission owners and proposals for generation resources within and outside the Northwest suggest that demands on these interconnections in the future may exceed their present-day capabilities. The following sections discuss each of the major interfaces, recent historical usage, and potential projects to increase their capabilities.

Each diagram includes five years of data, 2006 thru 2010. The light blue jagged line in the background shows the 2010 hourly flow data in chronological order from January through December (in MW). These chronological data show how the flows vary throughout the year. These same data and the data for 2006, 2007, 2008 and 2009 are also shown re-ordered and plotted from highest to lowest flow for each year. Annual changes and trends can be determined from these data. These charts can vary from year to year due to load levels, hydro conditions, market conditions, etc.

1. Northwest to British Columbia

The Northwest to British Columbia path consists of two 500 kV lines (Ingledow-Custer #1 & #2) and two 230 kV lines, Nelway-Boundary and Waneta-Boundary (which is normally open). The path is rated 3,150 MW north-to-south and 2,000 MW south-to-north.

The historical loading on this path is shown in Figure H-1. As can be seen from the figure, this interface is used in both directions, although the predominant flow is south to north. Generally, the path flows are in the south-to-north direction in the fall, winter and spring when the return of the downstream benefit of U.S. dams to Canada is the predominant influence. In the summer, Canada typically is exporting large amounts of power to the Northwest and California, and the flows are

in the north-to-south direction. Depending on the relative generation development plans in the United States and Canada, increased utilization in either or both transfer directions could occur.

Five projects are currently in the planning and/or permitting phase that could increase the capability of this interface.

Northern Intertie South-to-North Rating Increase Project: Minor upgrades to the existing path have been constructed and the path is being uprated. A south-to-north capability increase from 2,000 to 3,000 MW on this path is contemplated. This rating increase is currently under study by Bonneville and BC Hydro. The study results are being coordinated through the ColumbiaGrid Puget Sound Area Study Team.

Juan de Fuca Cable #1 Project: This project is described in more detail in the Major Regional Projects section of this report. The intent of the proposed 550 MW undersea cable between Vancouver Island and Port Angeles, Washington and associated system reinforcements is to export potential future wind generation development on Vancouver Island to the United States. Transfers into Canada from the Northwest are also possible. The sponsor is Sea Breeze Pacific.

Juan de Fuca Cable #2 Project: This project is described in more detail in the Major Regional Projects section of this report. The intent of the proposed 1,100 MW undersea cable between Vancouver, British Columbia and either Shelton or Olympia Substations on the Olympic Peninsula and associated system reinforcements is to export potential future wind generation development in British Columbia to the United States. Transfers into Canada from the Northwest are also possible. The sponsor is Sea Breeze Pacific.

Northern Lights Project: This project is described in more detail in the Major Transmission Projects section of this report. The intent of this proposed 3,000 MW DC transmission line from Alberta to Oregon is to export wind and other types of generation to the Northwest and also to import Northwest resources to Alberta. The sponsor is TransCanada.

The Canada-Pacific Northwest-Northern

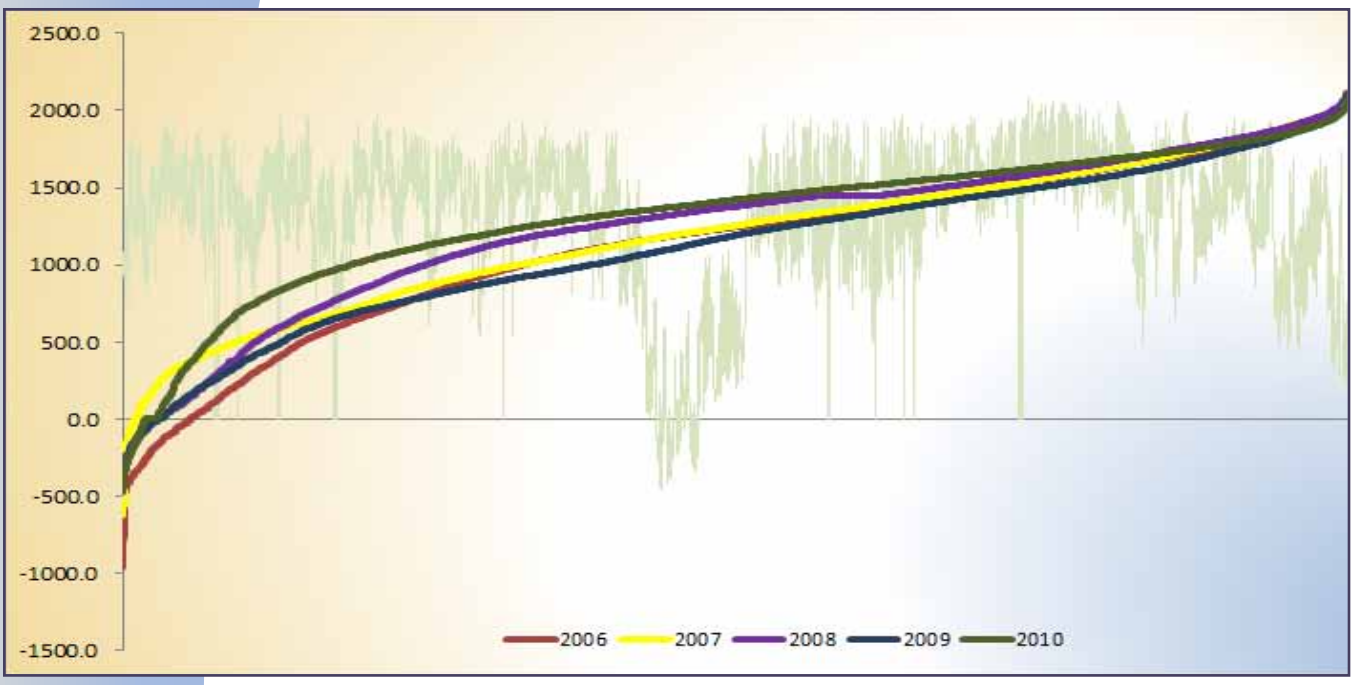


Figure H-2: Montana to Northwest

California Transmission Line Project: This project is described in more detail in the Major Transmission Projects section of this report. The project could add up to 3,000 MW of transmission capability between Canada, the Northwest, and California although smaller upgrades are also being contemplated. The primary purpose of the project is to provide California with access to Canadian renewable resources. The project also includes connections to the Northwest that will provide access to these same resources.

2. Montana to the Northwest

The Montana to the Northwest path consists primarily of the Broadview-Garrison #1 and #2 500 kV lines. In addition, the path contains four 230 kV lines, three 115 kV lines, and a 230/161 kV transformer. The path has an east-to-west rating of 2,200 MW and a west-to-east rating of 1,350 MW.

The historical loading on this path is shown in Figure H-2. As can be seen from the figure, this interface only reaches its maximum capability in the east-to-west direction, as the primary purpose of the path is to deliver major resources, such as the Colstrip Power Plant, to the Northwest. During peak load periods, the loading on this path can be lower in response to loads in Montana consuming more of the available resources. Several proposals for additional resources in Montana indicate that the transmission loadings on this path can be expected to increase.

In addition to the committed Colstrip Upgrade project, there is one other project in the planning phase to increase the transmission capability of this path.

The Garrison-Ashe Project is a 430 mile series compensated Garrison-Ashe 500 kV line that is being discussed with an intermediate station between Taft and Hot Springs to integrate additional renewables in Montana. Other options include starting the line farther to the east at Broadview.

3. Idaho to the Northwest

The Idaho to the Northwest path consists of the Hemingway-Summer Lake 500 kV line, the Imnaha-Lolo 230 kV line, the Hells Canyon-Enterprise 230 kV line, the Quartz Tap-LaGrande 230 kV line, and the Hines-Harney 115 kV line. The path has an east-to-west rating of 2,400 MW and a west-to-east rating of 1,200 MW.

The historical loading on this path is shown in Figure H-3. As shown, this path generally delivers power to the Northwest during the fall and winter, and delivers Northwest power to Idaho during the spring and summer.

In addition to the committed Boardman-Hemingway project, the Hemingway-Captain Jack 500 kV line project has also been proposed. This 500 kV line starts near Boise and traverses to Captain Jack Substation near Klamath Falls, Oregon. It has been proposed by PacifiCorp to increase transfer capability for new wind generation and other resources planned in Idaho, Wyoming and Montana.

4. Northwest to California

There are two major connections between the Northwest and California: the California - Oregon Interties (COI) and the Pacific DC Intertie. The COI consists of the two Malin-Round Mountain 500 kV lines (the Pacific AC Intertie) and the Captain Jack-Olinda 500 kV line (the California-Oregon Transmission Project). The COI is rated at 4,800 MW north-to-south and 3,675 MW from south-to-north. The Pacific DC Intertie is a +/- 500 kV bipole DC line between The Dalles, Oregon and Los Angeles, California. The Pacific DC Intertie is rated 3,100 MW in both directions.

The historical loading on these paths is shown in Figures H-4 and H-5. As shown, this interface frequently operates at its maximum capability in the north-to-south direction, but does not reach its capability in the south-to-north direction. Loadings are highest in the north–to-south direction in the spring and summer when Northwest and Canadian generation is being delivered to loads in California. During the winter, flows tend to be in both directions. These loadings are usually in the south-to-north direction when northwest loads peak

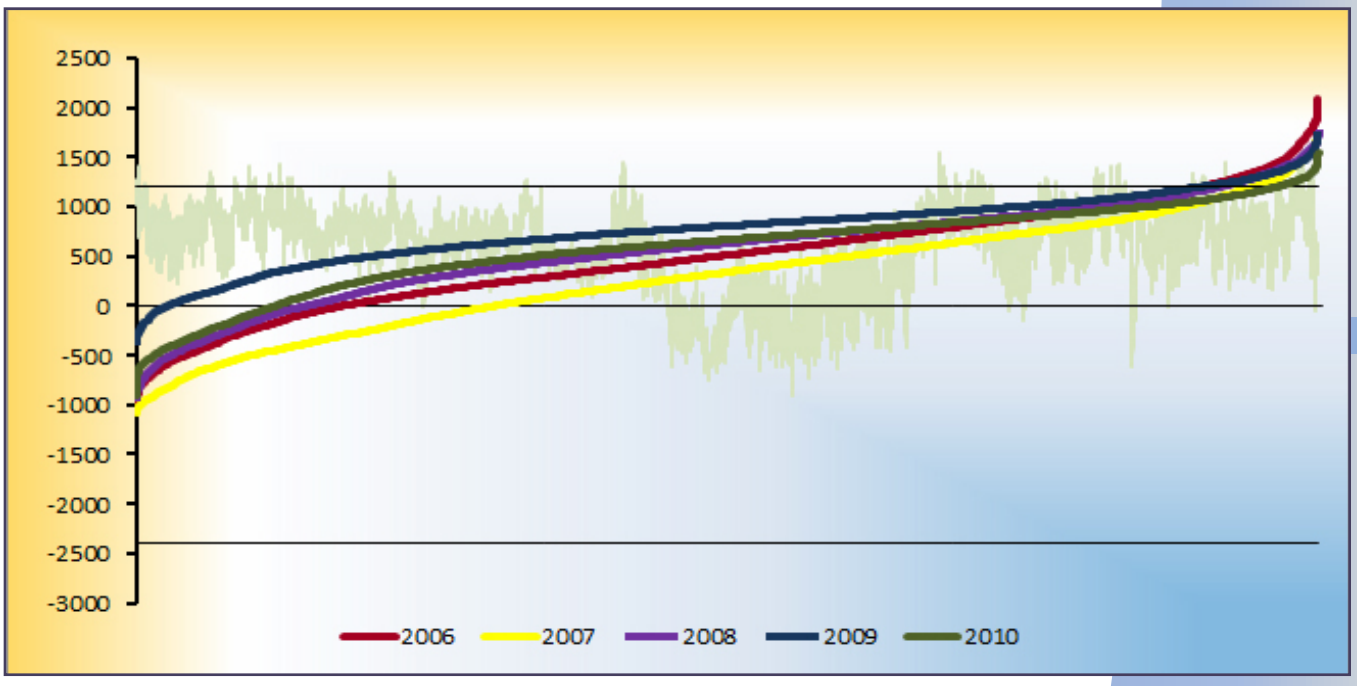


Figure H-3: Idaho to Northwest

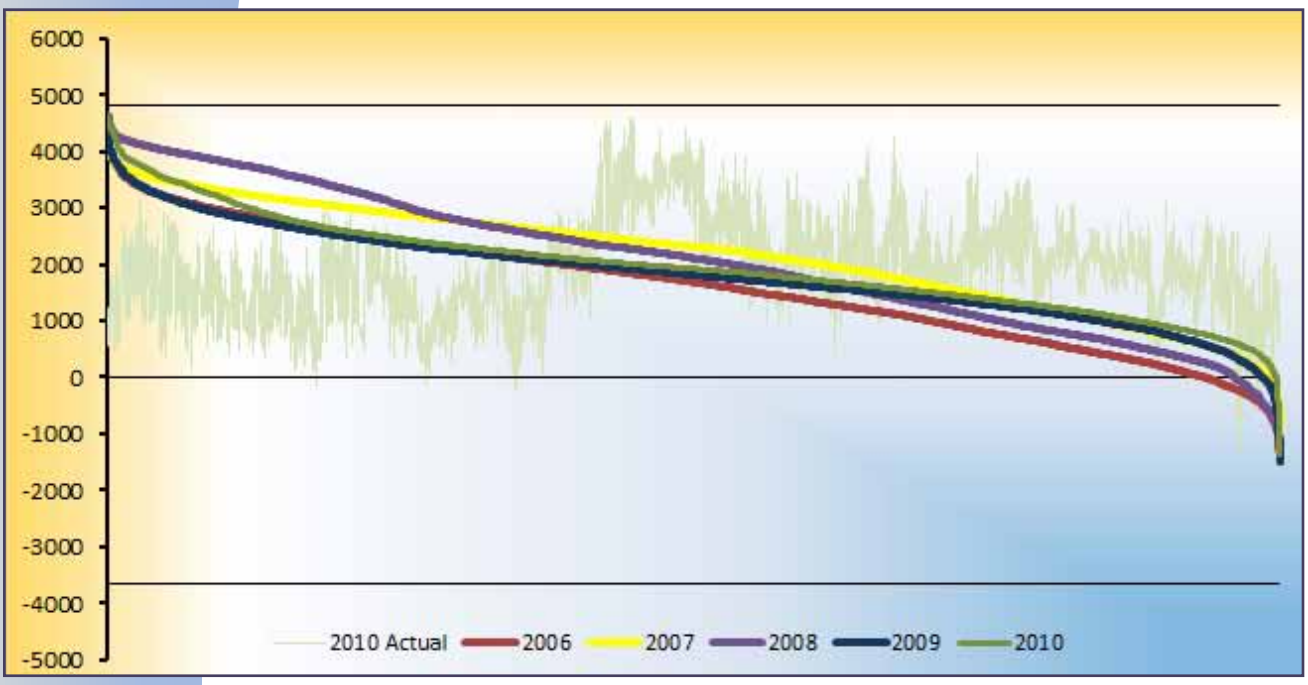


Figure H-4: California - Oregon Interties

in the winter as California resources are used to help meet the peak load requirements. A trend toward increasing north-to-south transfers is expected as a result of California entities purchasing several Northwest wind generation plants. Bonneville has recently completed a California-Oregon Interties Upgrade Project that includes the addition of shunt and series capacitors to enable this interface to be utilized at its full capability more often. This project does not increase the existing rating but improves the availability of the full rating, which currently is rarely available to operations. This project was completed in 2011.

Two projects are currently in the planning phase to increase the capability of this interface.

West Coast Cable Project: The intent of this proposed 1,600 MW undersea cable between Oregon and California is to export potential future wind development in the Northwest to California. The sponsor is Sea Breeze Pacific. This project starts at Allston Substation in northwest Oregon and extends to Newark Substation in the San Francisco Bay area.

The Canada/Pacific Northwest to Northern California Project: As described previously, this project would add up to 3,000 MW of transmission capability between Canada, the Northwest, and California. The primary purpose of this project is to provide California with access to Canadian and Northwest renewable resources.

5. Northwest to Nevada (Alturas tie to Sierra):

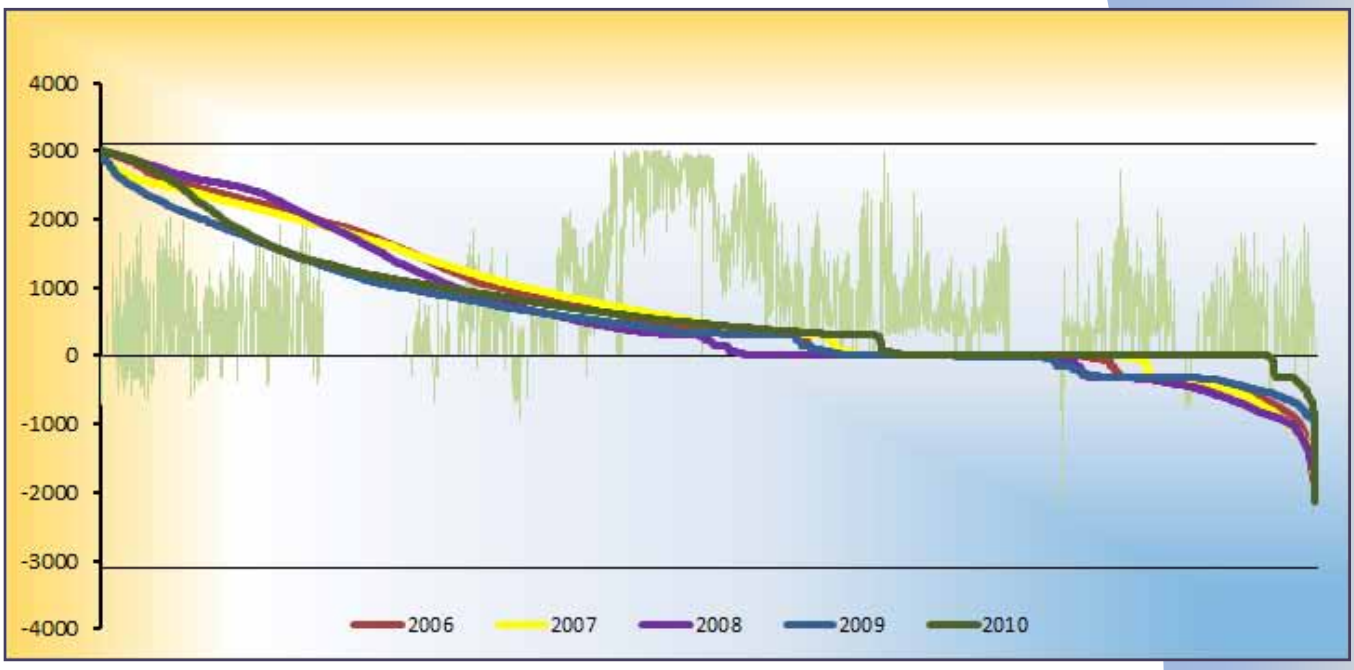


Figure H-5: Pacific DC Intertie

The Alturas line is a 300 MW bi-directional path between southern Oregon and the Reno, Nevada area and is typically used to transfer Northwest resources to Nevada. The historical flows are shown below in Figure H-6. There are no known plans to upgrade this path.

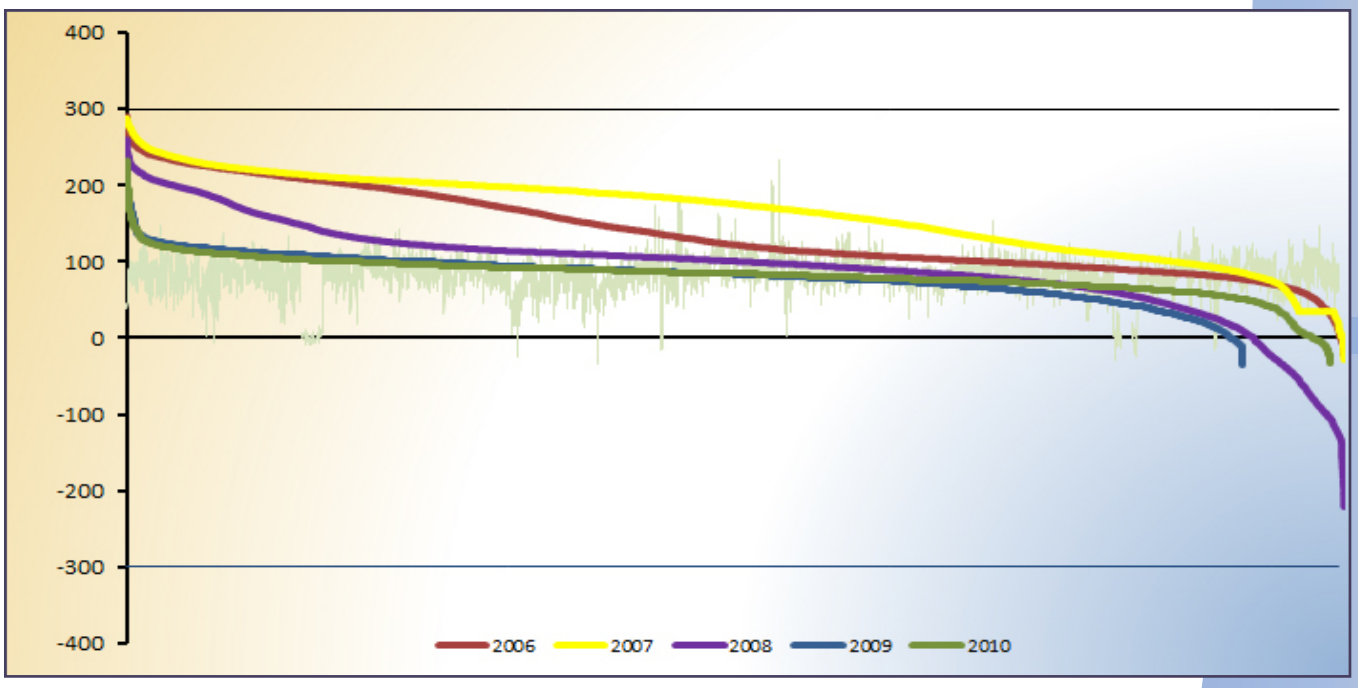


Figure H-6: Alturas

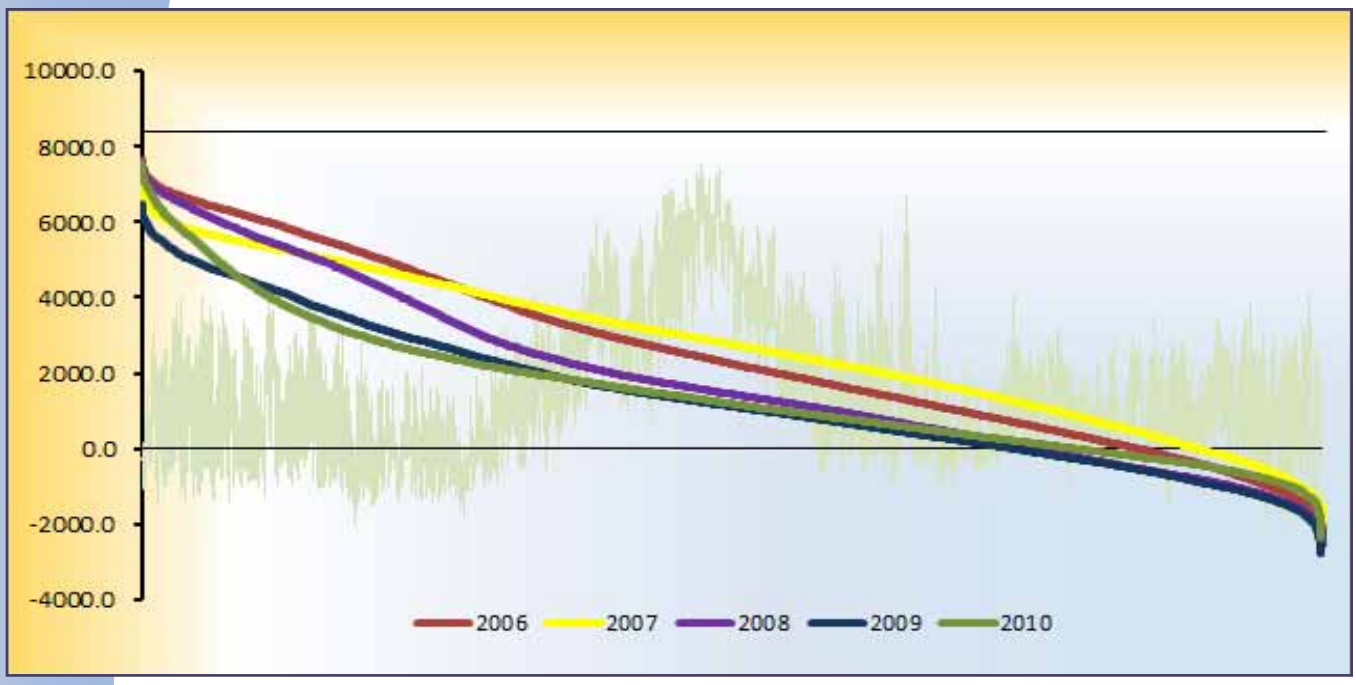


Figure I-1: North of John Day

Internal Interfaces

The flows between the Northwest and other sub-regions in combination with the internal northwest generation and loads, determines the flow on the Northwest's internal transmission system. Several internal interfaces have been defined in critical areas for monitoring and operation of the system. These internal interfaces include North of John Day, South of Allston, West of McNary, West of Cascades North, West of Cascades South and West of Hatwai. This section discusses these interfaces, recent historical usage, and potential projects to increase their capabilities.

1. North of John Day

The North of John Day path consists of six 500 kV lines; Raver-Paul, Wautoma-Ostrander, Wautoma-John Day, Ashe-Marion, Ashe-Slatt and Lower Monumental-McNary. This path shows the stress on the system in the lower Columbia area due to spill (when this generation is replaced by more remote generation, additional stress is placed on the system). This path helps determine the total export capability to California. The maximum rating of this path is 8400 MW.

The flows on this path are shown in Figure I-1. This path loads most heavily in spring and summer when water is being spilled over the lower Columbia dams for fish migration and power is being exported to California. Its use is much reduced in fall and winter when spill is minimal and northwest resources are used to meet northwest loads.

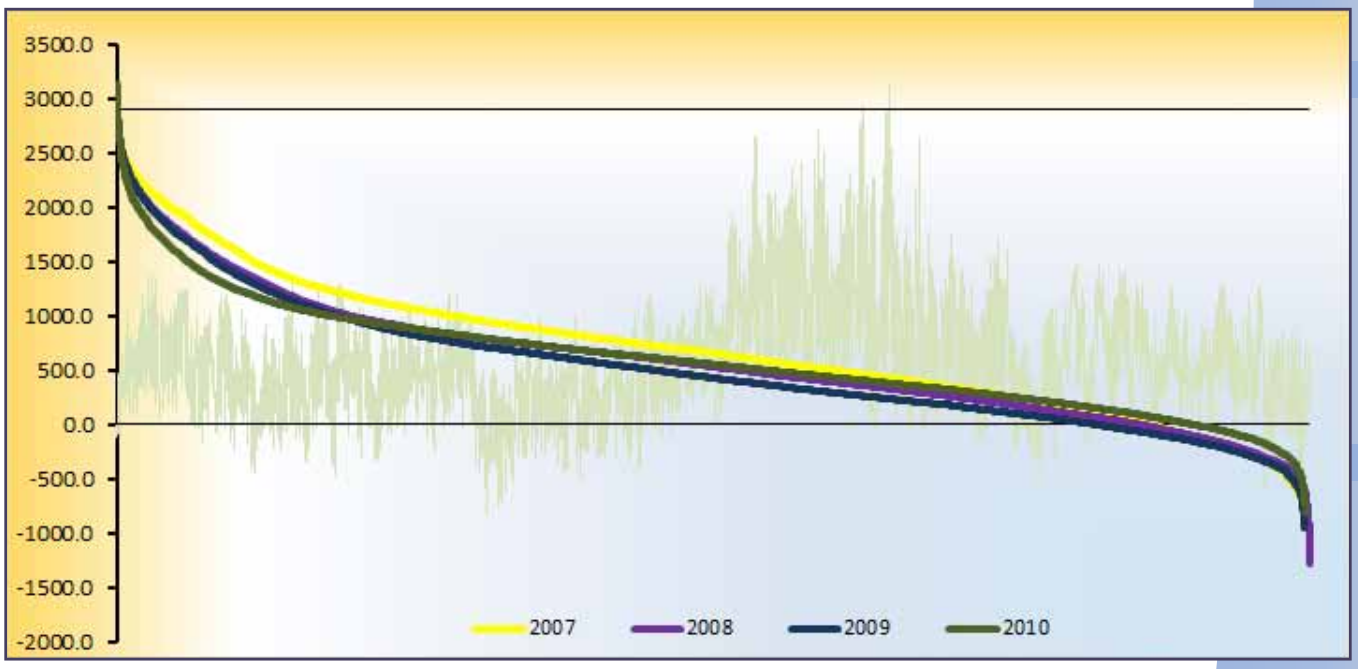
There are some proposed projects that would upgrade this path including: Bonneville's I-5 Corridor Reinforcement project (Castle Rock-Troutdale), TransCanada's Northern Lights Project and PG&E's Canada-Pacific Northwest to Northern California Project. The Big Eddy-Knight project could also provide capacity increases to this path.

2. South of Allston

The South of Allston path consists of the Allston-Keeler 500 kV line, the Allston-Rainier 115 kV line, the Astoria Tap-Seaside 115 kV line, the Merwin-View 115 kV line, the Trojan-Rivergate 230 kV line, the Trojan-St Marys 230 kV line and the Woodland Tap-Ross 230 kV line. This path is rated at approximately 2,900 MW (the actual rating is determined by seasonal OTC studies and system conditions). This path is limiting in summertime when northwest hydro generation is limited and exports to California are supplied with imports from Canada and west side gas resources. Flows on this path are much lower in other seasons. Recent loading on this path is shown in Figure I-2.

Bonneville's I-5 Corridor Reinforcement Project would substantially increase the capability of this path. Portland General Electric's Horizon Phase II Project could provide an increase in capability for the South of Allston path (south of Trojan).

Figure I-2: South of Allston



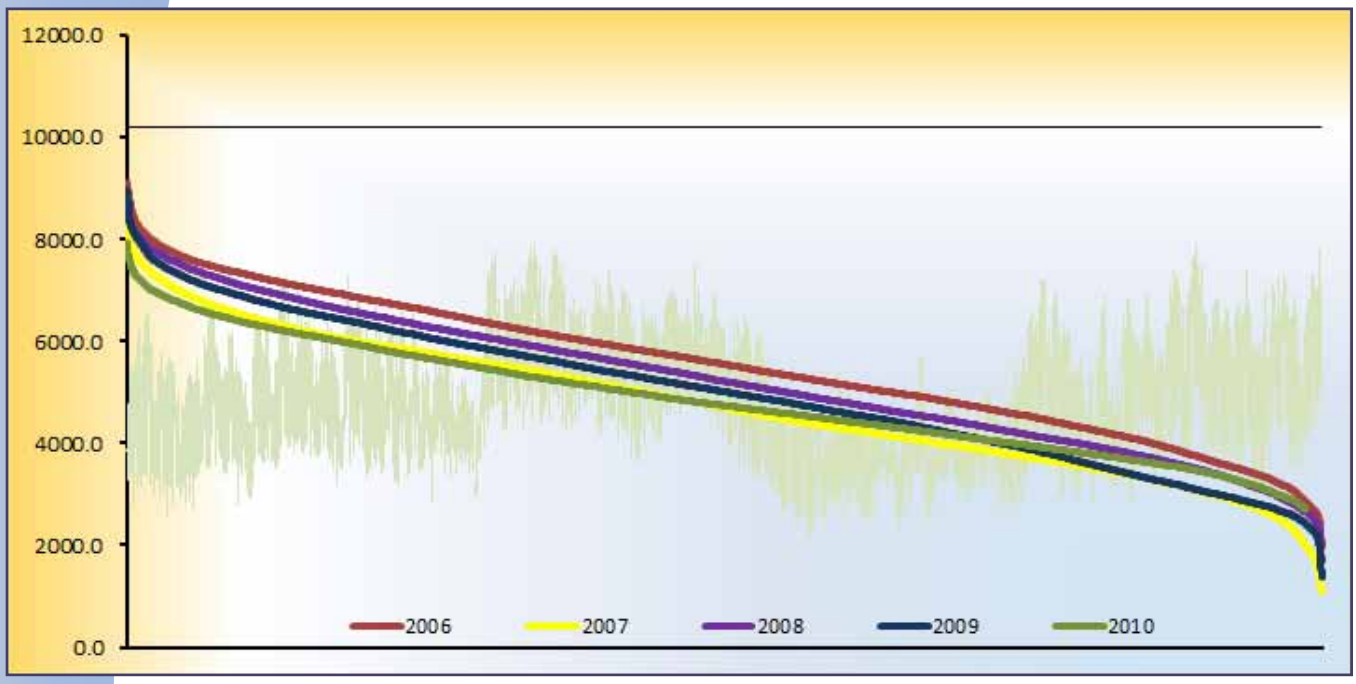


Figure I-3: West of Cascades North

3. West of Cascades North

The West of Cascades North Path consists of the Chief Joseph-Monroe 500 kV line, the Schultz-Raver #1, #3, and #4 500 lines, the Chief Joe-Snohomish 345 kV #3 and #4 lines, the Rocky Reach-Maple Valley 345 kV line, the Coulee-Olympia 300 kV line, the Rocky Reach-White River 230 kV line, the Columbia-Covington 230 kV line and the Schultz-Echo Lake 500 kV line. This path is rated at 10,200 MW.

This path is most limiting in the winter when temperatures are low and loads are high in the Northwest, especially if local west side generation is unavailable and/or exports to Canada are high. Loading on this path is typically not critical in other seasons. Recent loading on this path is shown in Figure I-3.

Proposed projects that would upgrade this path include Puget Sound Energy's IP Line uprate to 230 kV and Bonneville's series capacitors at Schultz. Several other options are being investigated by the Cross Cascades Study Team.

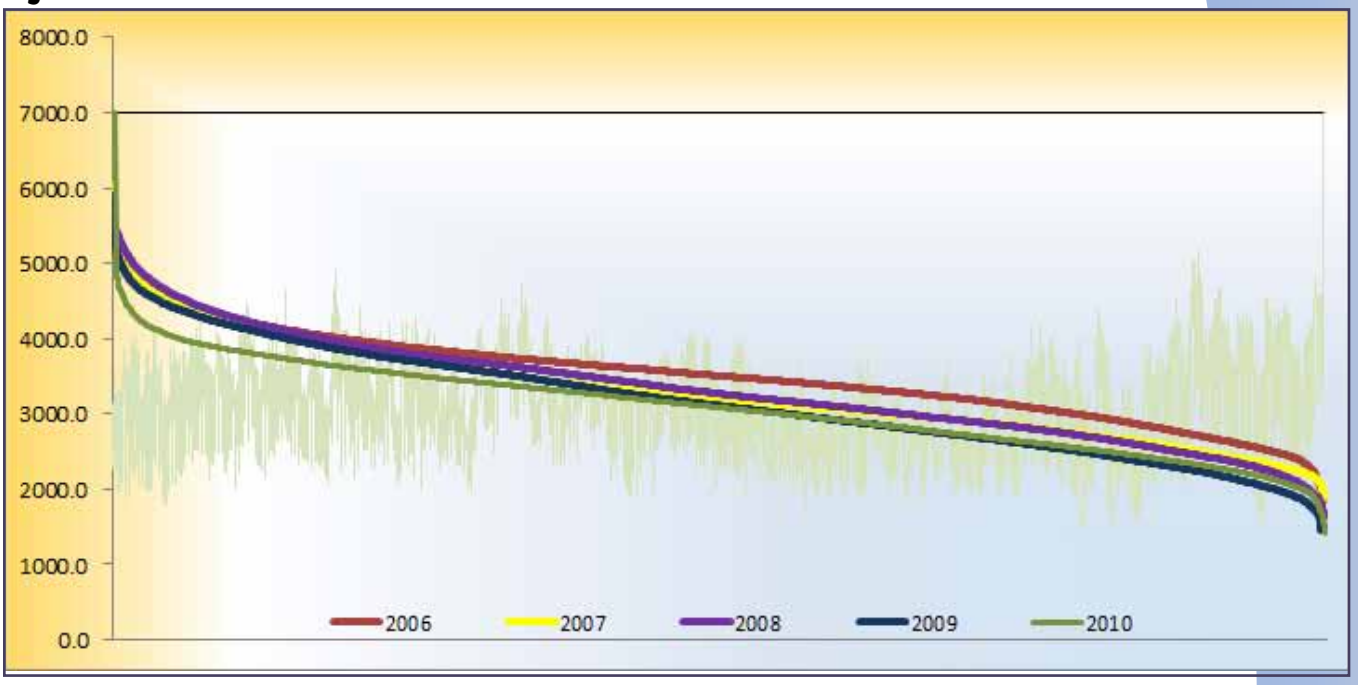
4. West of Cascades South

This path consists of the Big Eddy-Ostrander 500 kV line, the Ashe-Marion 500 kV line, the Buckley-Marion 500 kV line, the Wautoma-Ostrander 500 kV line, the John Day-Marion 500 kV line, the McNary-Ross 345 kV line, the Big Eddy-McLoughlin 230 kV line, the Big Eddy-Chemawa 230 kV line, the Midway-North Bonneville 230 kV line, the McNary-Santiam 230 kV line, the Big Eddy-Troutdale 230 kV line and the Round Butte-Bethel 230 kV line. This path is rated at approximately 7000 MW.

This path is most limiting in the winter when temperatures are low and loads are high in the Northwest, especially if local west side generation is unavailable. Loading on this path is usually not critical in other seasons. Recent loading on this path is shown in Figure I-4.

Projects proposed that would upgrade this path, or add parallel capacity, include Bonneville's Big Eddy-Knight project (which is part of the West of McNary Area

Figure I-4: West of Cascades South



Reinforcement) and Portland General Electric's Cascade Crossing Project. Although the West of McNary project is modeled in the studies, the incremental rating increase on the West of Cascades South path is not known at this time so the existing rating was included in the studies.

5. West of McNary

The West of McNary path consists of the following lines; Coyote-Slatt 500 kV line, McNary-Ross 345 kV line, McNary-Horse Heaven 230 kV line and the Boardman 230 kV line. The purpose of this path is to measure the stress on the system when there is heavy generation in the McNary area and transfers to the west. The rating of this path is 2870 MW.

This path is most limiting in the spring of the year. Path flows typically recede under

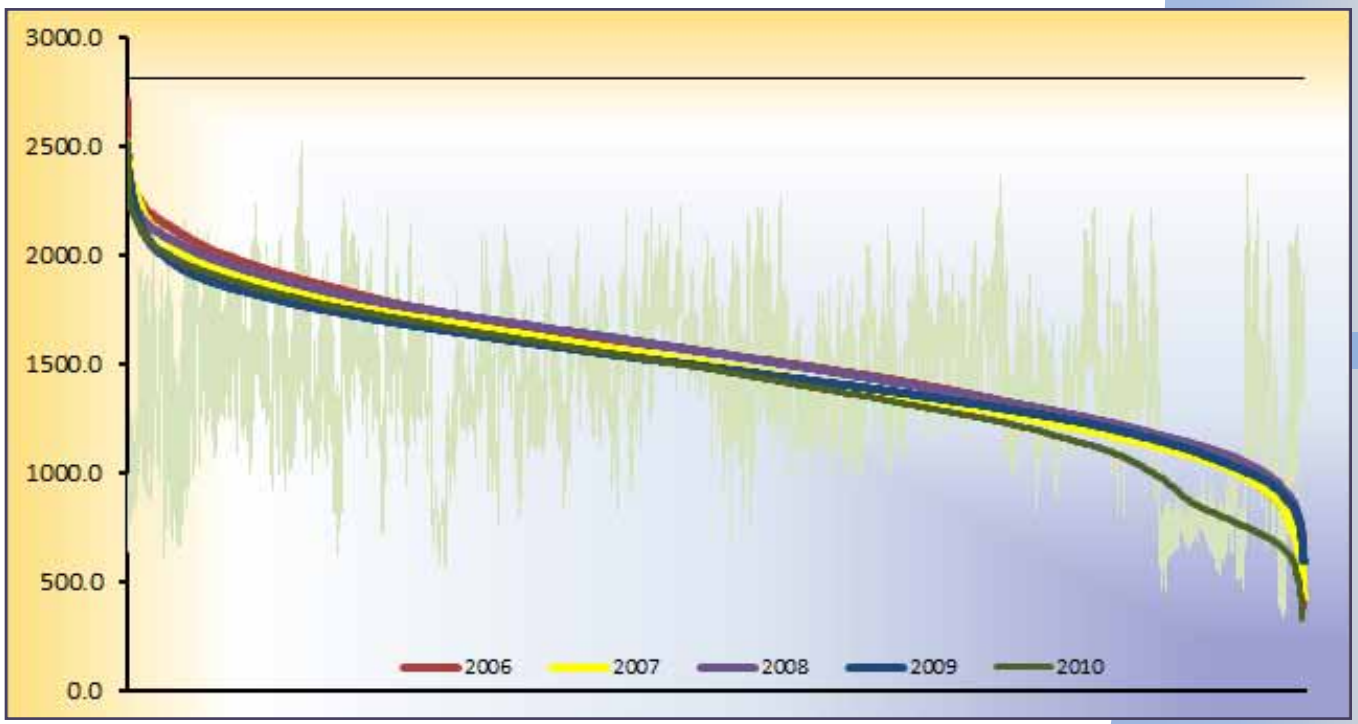


Figure I-5: West of McNary

summer and winter conditions. Recent loading on this path is shown in Figure I-5.

Projects proposed or recently built that would increase the capacity of this path, or add parallel capacity, include Bonneville's West of McNary Area Reinforcement Project and Portland General Electric's Cascade Crossing Project.

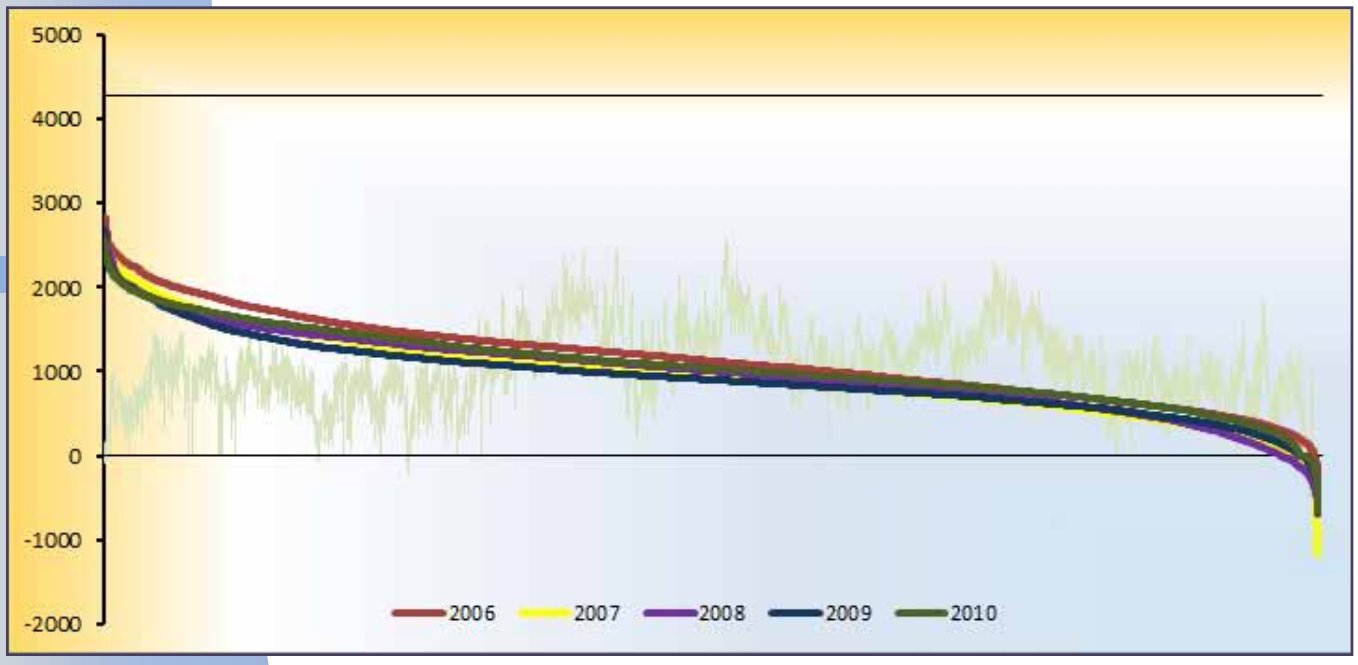
6. West of Hatwai

The West of Hatwai path consists of the following lines; Hatwai - Lower Granite 500 kV, Bell - Coulee 230 kV #3 and #5, Westside – Grand Coulee 230 kV, Dry Creek -Walla Walla 230 kV, Bell - Creston 115 kV, North Lewiston - Tucannon River 115 kV, Harrington Odessa 115 kV, Lind - Roxboro 115 kV, Dry Gulch 115/69 kV transformer and Bell – Grand Coulee 500 kV lines. This path is rated at 4277 MW.

The purpose of this path is to measure the stress on the system when there is heavy generation in Montana and Northern Idaho and transfers through eastern Washington to the west. This path is most limiting in the spring of the year. Path flows are typically lower under summer and winter conditions. Recent loading on this path is shown in Figure I-6.

This project was recently upgraded with the Bell-Coulee 500 kV line and several other Avista line upgrades. A Garrison – Ashe 500 kV line project has been identified in the BPA NOS process to meet additional transmission requests between Montana and the Northwest. The Colstrip Upgrade project discussed earlier would increase the capacity of the Montana to Northwest path but would also increase the loading on the West of Hatwai path (the Colstrip project would not increase the capacity of West of Hatwai).

Figure I-6: West of Hatwai



Study Assumptions and Methodology for the System Assessment

The Northwest transmission grid is interconnected and as result, it was necessary for all Northwest entities to participate in the development of this Expansion Plan whether or not they are parties to the ColumbiaGrid PEFA. Major transmission owners in the Northwest were notified individually and encouraged to participate in the planning process. All participants who provided input to the study or helped to screen results had access to the same information whether or not they were parties to PEFA.

The major assumptions that form the basis of the System Assessment are load, generation, external path flows, and planned transmission additions. These assumptions were used to develop the cases that were studied in the System Assessment. The approach used for developing each of these assumptions is summarized below.

Base Case Development

ColumbiaGrid normally develops five and ten-year base cases for winter peak load, summer peak load and light load conditions. A current ten-year winter case was not available so a seven-year winter peak load case was used in the 2011 System Assessment (2018HW1-S). This case models heavy wind generation which is different than the prior year assessment's ten-year peak load case which modeled very little wind generation. Additional studies are planned as part of the 2012 System Assessment when a true ten-year winter case becomes available next spring. The ten-year summer peak load case used in the 2011 System Assessment is the 2021 HS2 case. The five-year cases used were based on the recent 2015-16 Heavy Winter case (16HW2) and the 2016 Heavy Summer case (16HS2).

All of the base case assumptions, such as the load levels modeled, the generation

patterns modeled, and the transmission configurations, were selected by the ColumbiaGrid Planning participants during open meetings. Corrections and updates to transmission and resources were made to all of the cases to ensure that they would be as accurate as possible. Each case was analyzed under the no outage condition and any deficient areas were noted and corrections or updates were made as appropriate.

Load Modeling Assumptions

As required in the NERC Reliability Standards, the transmission system is planned for expected peak load conditions. Normal summer and winter peak loads were based on a probability of 50 percent not to exceed the target load peak.

As modeled in the base cases, the total winter peak load for the Northwest system is forecasted to be 32,260 MW in the five-year case (this is down from 33,141 MW in last year's System Assessment) and 32,632 MW in the seven-year case. The forecast summer peak load is 26,145 MW in the five-year case (this is down from the 27,247 MW modeled in last year's case) and 27,535 MW in the ten-year case (28,731 MW was modeled in last year's case). While the Northwest system as a whole peaks in the winter, this does not mean that summer conditions require less attention. The capacity of electrical equipment is often limited by high temperatures, which means the equipment has lower capacity in summer than in winter. As a result, it is possible that a lower summer load can be more limiting than a higher winter load due to the ambient temperature differences and the impact on equipment.

Resource Modeling Assumptions

Resource additions ten years into the future are much more difficult to forecast than loads. Although there are numerous potential generating projects in the region in various stages of development, there is much uncertainty for a variety of reasons about whether and when they will come into service. Many of the variables are outside the control of transmission providers. Adding to the complexity, these resource assumptions are particularly important. Depending upon their location, some resources can mask transmission problems while others can create new problems.

While the existing northwest resources are adequate to meet summer loads, they are not adequate to meet winter peak loads. Northwest utilities rely on seasonal diversity in resource needs with other regions to meet winter load obligations by importing from California and the Southwest. For this reason, imports into the Northwest from California were used to meet the shortfall of new resource additions in the Northwest. However, there are many indicators, such as the number of requests for interconnection that transmission providers have received, to suggest that other resources will be developed in the region during this ten-year planning horizon. The addition of proposed generation projects, especially thermal projects on the west-side of the Cascades, could have a significant impact on the performance of the transmission system and reduce the reliance on California imports that was assumed in the winter cases. Planned transmission projects will be reviewed periodically to determine whether changes in resource additions would impact the need for, or scope of, these projects.

One generation retirement was included in the base cases. The state of Washington has come to an agreement with the owner of the Centralia Power Plant to retire one 700 MW coal-fired unit in 2020 and the second unit in 2025. Since the removal of this plant is in the latter part of the planning horizon, the system was assessed both with the plant in service and retired to cover both conditions. The retirement of the first unit was modeled as a sensitivity in the ten-year case.

There is a significant amount of new wind generation proposed in the ColumbiaGrid footprint. Figure E-3 shows the wind resources, along with projects under construction and projects proposed as of June 2011. The amount of proposed wind generation in this updated chart for Oregon and Washington is about the same as was identified in previous versions of this map which may indicate a slowing of wind generation growth on the horizon. Although there is significant wind generation potential in eastern Washington and Oregon, there is much more potential in Idaho, Montana, and Wyoming. The required transmission additions to deliver those remote resources are significant, but very limited new transmission capability is planned to enable these wind resources to reach the Northwest.

Although there are several thousand MWs of wind generation in the Northwest, none is usually modeled during the peak load conditions in the System Assessment. Historical operation has shown there is often little wind generation during either winter or summer peak load conditions. Operation without wind generation results in increased reliance on local gas generation and/or increased imports from California and the southwest. However, in the 2011 System Assessment, to investigate the effects on the grid should substantial amounts of wind generation be available during peak-load periods, the planning participants decided to analyze the 2018 HW1-S case which models heavy wind generation in the Northwest under winter peak load conditions.

To balance the load and generation in the Northwest, ColumbiaGrid assumed 716 MW was imported into the Northwest from California over the California-Oregon Interties in the five-year winter study. For the seven-year winter study, ColumbiaGrid assumed 1136 MW was imported into the Northwest on the combined Pacific DC Intertie and the California-Oregon Interties.

A list of the resources used in the base cases is included in Attachment A.

Transmission Modeling Assumptions

As required by the NERC Reliability Standards and PEFA, it was necessary to model firm transmission service commitments in the System Assessment. PEFA requires that plans need to be developed to address any projected inability of the PEFA planning parties' systems to serve the existing long-term firm transmission service commitments during the planning horizon, consistent with the planning criteria. The NERC reliability standards do not allow any loss of demand or curtailed firm transfers for Level B contingencies (single elements) and allow only planned and controlled loss of demand or curtailment of firm transfers for Level C contingencies (multiple elements).

The ColumbiaGrid planning process assumes that all ColumbiaGrid members' transmission service and native load customer obligations represented in WECC and ColumbiaGrid base cases are firm, unless specifically identified otherwise (such as interruptible loads).

The firm transmission service commitments between the Northwest and areas outside the Northwest are scheduled on specific transmission paths (e.g., British Columbia-Northwest, Montana-Northwest, Idaho-Northwest, California-Oregon Interties, and Pacific DC Intertie). These external paths were modeled at loading levels at least as high as their known firm transmission service commitments.

Conversely, the transmission paths internal to the Northwest are not scheduled. The flows on internal paths are a result of flows on the external paths, internal resource dispatch, internal load level, and the transmission facilities that are in service.

Of the external paths, the British Columbia-Northwest and the two California Interties are most crucial during peak load conditions. These paths are bi-directional and there are often different stresses during winter and summer conditions. The Montana-Northwest and Idaho-Northwest paths are stressed more during off-peak load conditions and are less important during peak load conditions. The adequacy of these latter paths is verified annually through operational and light load studies.

During the winter, returning the firm Canadian Entitlement to British Columbia is the predominant stress on the Puget Sound area and the British Columbia-Northwest path. ColumbiaGrid modeled 1,500 MW of firm transfers on this path to represent the long-term firm transmission service commitments

Base Case Summary (MWs)	5 Year Summer	5 Year Winter	10 Year Summer	7 Year Winter, High Wind
	16HS2	16HW2	21HS1a	18HW
Total Northwest Load	**26,145**	**32,260**	**27,535**	**32,632**
Total Northwest Generation	**33,656**	**32,092**	**34,910**	**32,500**
Northwest - British Columbia Flow	-1,501	1,501	-1,477	1,300
Idaho - Northwest Path Flow	-559	900	-513	568
Montana - Northwest Path Flow	815	1,285	921	1,110
North of John Day Path Flow	7,689	1,402	7,602	-577
COI Path Flow	4,796	-716	4,801	-174
Pacific DC Intertie (PDCI) Path Flow	3,101	0	3,101	-962
South of Allston Path Flow	2,996	1,340	3,236	558
West of Cascades North Path Flow	4,695	8,420	4,706	7,735
West of Cascades South Path Flow	4,272	6,003	4,345	6,850
West of Hatwai Path Flow	-40	528	296	-25

Table J-1: Base Case Summary

expected throughout the planning horizon due to the Canadian Entitlement and those of Puget Sound Energy. In the winter, the California interties were used to balance the load and generation modeled in the studies. This results in moderate imports which is not uncommon in winter.

In the summer, transfers on the British Columbia-Northwest and California Interties are typically in the opposite direction as in winter. Surplus power resources from Canada and the Northwest are often sent south to California and the Southwest. There are 7,700 MW of projected firm north to south capacity rights on the combined California-Oregon Interties and Pacific DC Intertie in the five to ten-year planning horizon. The full 7,900 MW capacity of these two interties was modeled in the assessment studies. There are presently 1,335 MW of firm transmission rights in the north to south direction on the British Columbia-Northwest path. The summer commitments in the north to south direction were modeled as 1,500 MW to match the assumptions adopted by the Puget Sound Area Study Team.

The path flows in the assessment were within their limits. The West of Hatwai and West of McNary flows are quite low in these cases but that is expected, as these paths typically experience stress during off-peak conditions.

The path flows modeled in the System Assessment is shown in Table J-1. The background for the specific existing firm transmission service commitments on members' paths that were modeled in the Transmission Expansion Plan is as follows:

1. Canada to Northwest Path

The capacity of this path in the north to south direction is 2,850 MW on the west-side and 400 MW on the east-side with a combined total transfer capability limit of 3,150 MW. The total

capacity of the path in the south to north direction is 2,000 MW, with a limit of 400 MW on the east-side. Both of these directional flows can impact the ability of the system to serve loads in the Puget Sound area.

The Canadian Entitlement return is the predominant south to north commitment on this path and is critical during winter conditions. Although the total amount of commitment varies somewhat, 1,350 MW of firm transmission service commitments is projected for the 2020 studies. Puget Sound Energy also has a 200 MW share at full transfer capability into British Columbia, which translates to a 130 MW allocation at the 1,350 MW level. Bonneville has committed to maintaining this pro-rata share of the Northern Intertie above its firm transmission service commitments. Both of these firm transmission service commitments are on the west-side of the path so 1,500 MW of transfers are modeled in the south to north direction in winter.

With reduced loads in the Puget Sound area in the summer, the return of the Canadian Entitlement is not typically a problem. The most significant stressed condition in the summer is north to south flows of Canadian resources to meet loads south of the border.

Powerex has long-term firm rights for about 242 MW for their Skagit contract, plus 193 MW to Big Eddy and 450 MW to John Day, for a total of 885 MW in the north–to-south direction. Powerex also owns 200 MW of transmission rights for the Cherry Point Project which is just south of the Canadian border and can be reassigned to the border. Puget Sound Energy has long-term firm contracts for 150 MW and Snohomish has firm contracts for 100 MW. The total of all of these contracts is 1,335 MW.

The Puget Sound Area Study Team has been planning the system in the Puget Sound area system to maintain 1,500 MW in the north to south direction to cover these firm transfers. The System Assessment was designed consistent with this requirement by modeling 1,500 MW on the west-side of the Northern Intertie (and no flow on the eastside portion of this path).

2. Montana to Northwest Path

This path is rated at 2,200 MW east to west and 1,350 MW west to east. The predominant flow direction is east to west. The path can only reach its east to west rating during light load conditions. Imports into Montana usually only occur when the Colstrip Power Plant facilities are out of service.

The firm commitments on this path exceed 1,400 MW east to west. There are also some counter-schedules that reduce the actual flows on the system. For the five-year studies, flow was modeled as 1,285 MW in normal winter and 815 MW in summer. Flows are similar in the outer-year cases.

3. Northwest to California/Nevada Path

The combined COI and Pacific DC Intertie are rated at 7,900 MW in the north to south direction, although the combined operating limit can be lower due to the North of John Day nomogram. The COI is individually rated at 4,800 MW and the Pacific DC Intertie is rated at 3,100 MW. The 300 MW Alturas tie from Southern Oregon into Nevada utilizes a portion of the 4,800 MW COI capacity. In the south to north direction, the COI is rated at 3,675 MW and the Pacific DC Intertie is rated at 3,100 MW.

Bonneville is planning upgrades to these paths to increase the potential to use these

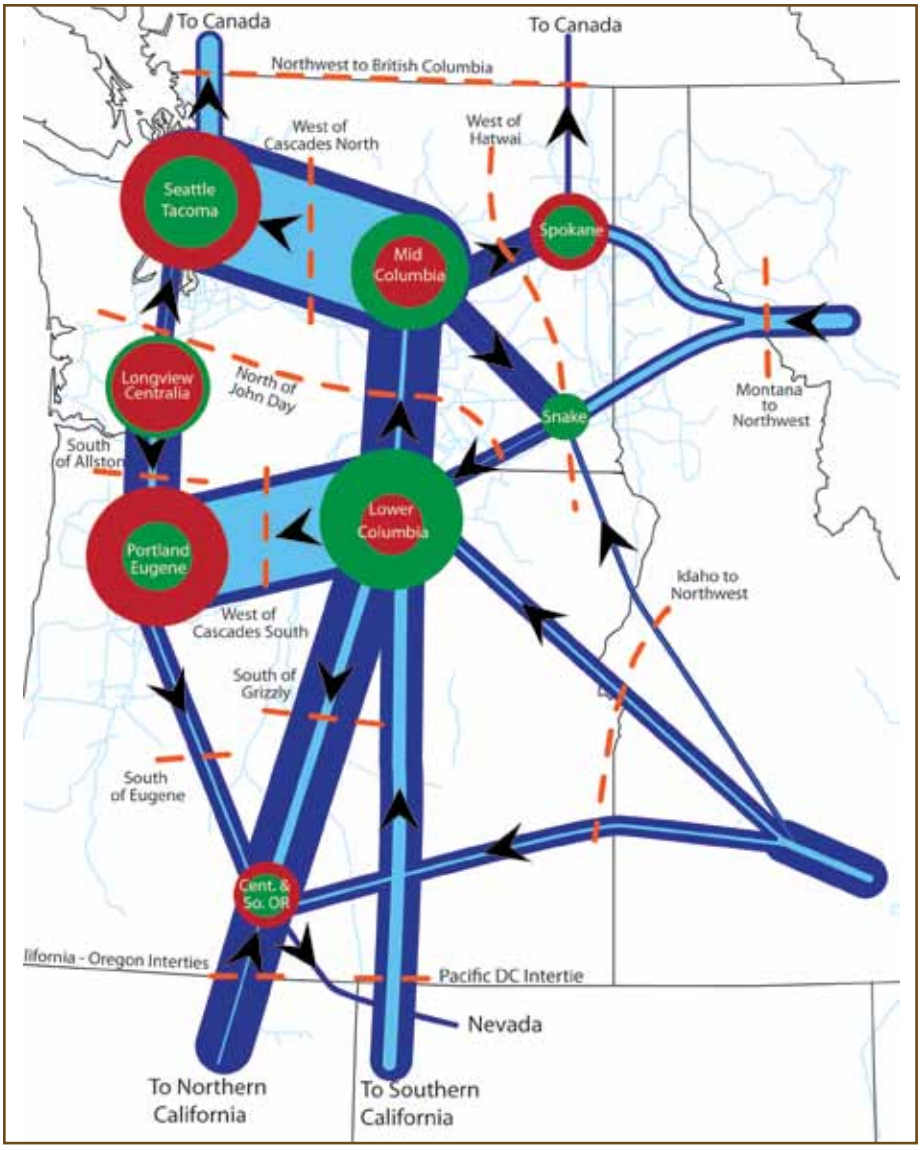
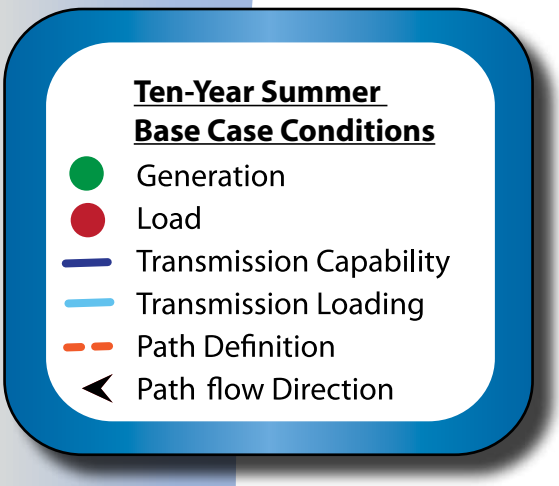


Figure J-1: Seven-Year Winter Base Case Conditions

paths at their full capability. After these upgrades, the long-term firm transmission service commitments on these paths are expected to total about 7,700 MW. To cover these commitments, these two interties were loaded close to their combined limit of 7,900 MW in the summer cases used in the System Assessment.

There are some firm transmission service commitments on this path in the south–to-north direction but not a significant amount. Non-firm sales are relied on by many parties in the winter, especially during very cold weather, when there are insufficient resources within the Northwest to meet the load level. For the base cases, Northwest resources were dispatched first, and firm transmission service commitments were modeled on external paths. Then additional resources needed to meet the remaining load obligations in the Northwest were imported from the south on the COI and Pacific DC Intertie.

In the five-year heavy winter base case, the imports into the Northwest totaled 716 MW with all the flow on the COI. The seven-year winter case has a total of 1,136 MW import on the combined COI and PDCI paths. In both the five-year and ten-year summer cases, the



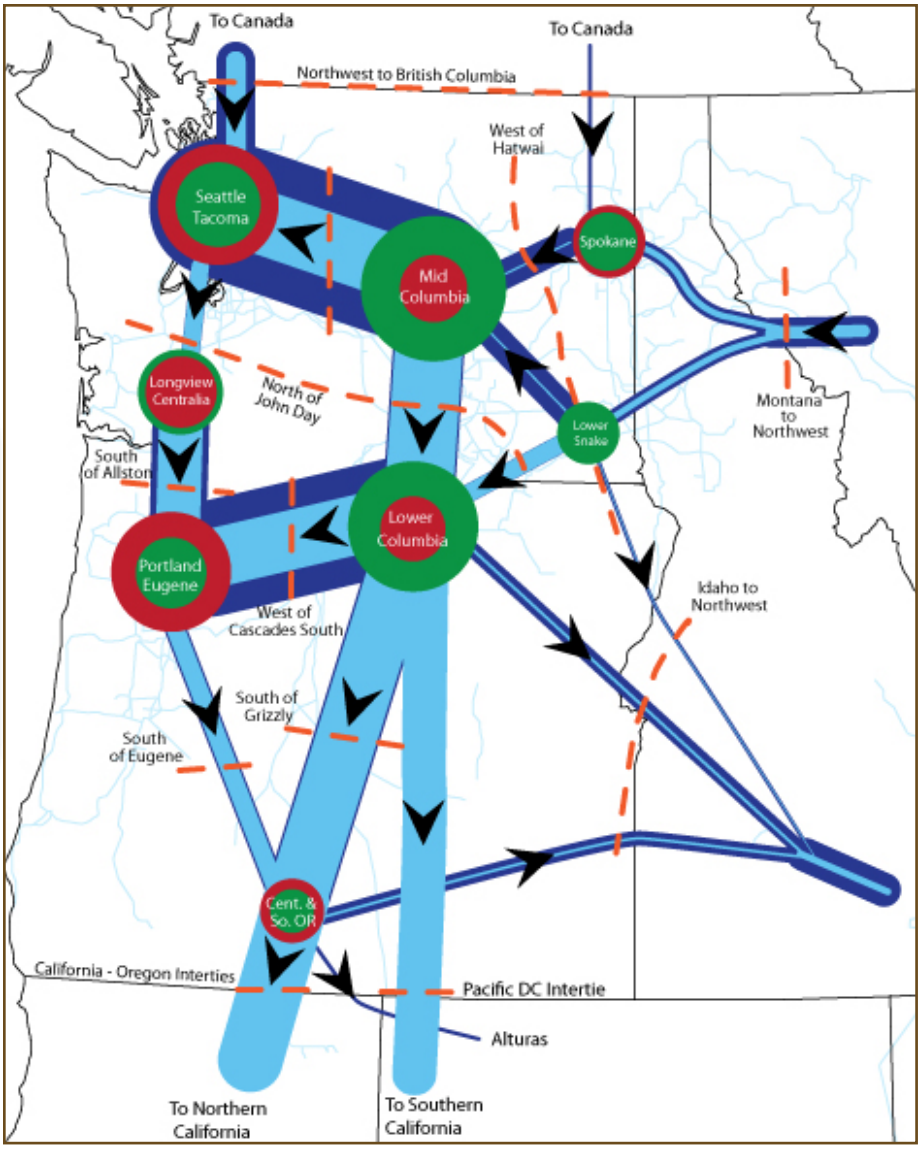


Figure J-2: Ten-Year Summer Base Case Conditions

combined exports were 7,900 MW, the full rating of the two interties.

4. Idaho to Northwest Path

The Idaho to Northwest path is rated at 2,400 MW east to west and 1,200 MW west to east. This path has about 300 MW of firm schedules into Idaho to meet firm transfer loads, in addition to a 100 MW point-to-point service contract. Summer conditions with flows at these levels are typical as there are few surplus resources to export from the east. In the winter, these transfer loads are reduced and PacifiCorp typically exports its east-side resources into the Northwest to meet its west-side load obligations. Due to the nature of the flows from Idaho, they are not expected to cause significant system problems during peak load periods.

For the five-year winter cases, 900 MW is modeled flowing into the Northwest. In summer, 560 MW was modeled flowing from the Northwest into Idaho. Flows were very similar in the respective ten-year cases.

5. West of Hatwai Path

The West of Hatwai path is rated at 4,277 MW in the east to west direction but it is not a scheduled path. This path is stressed most

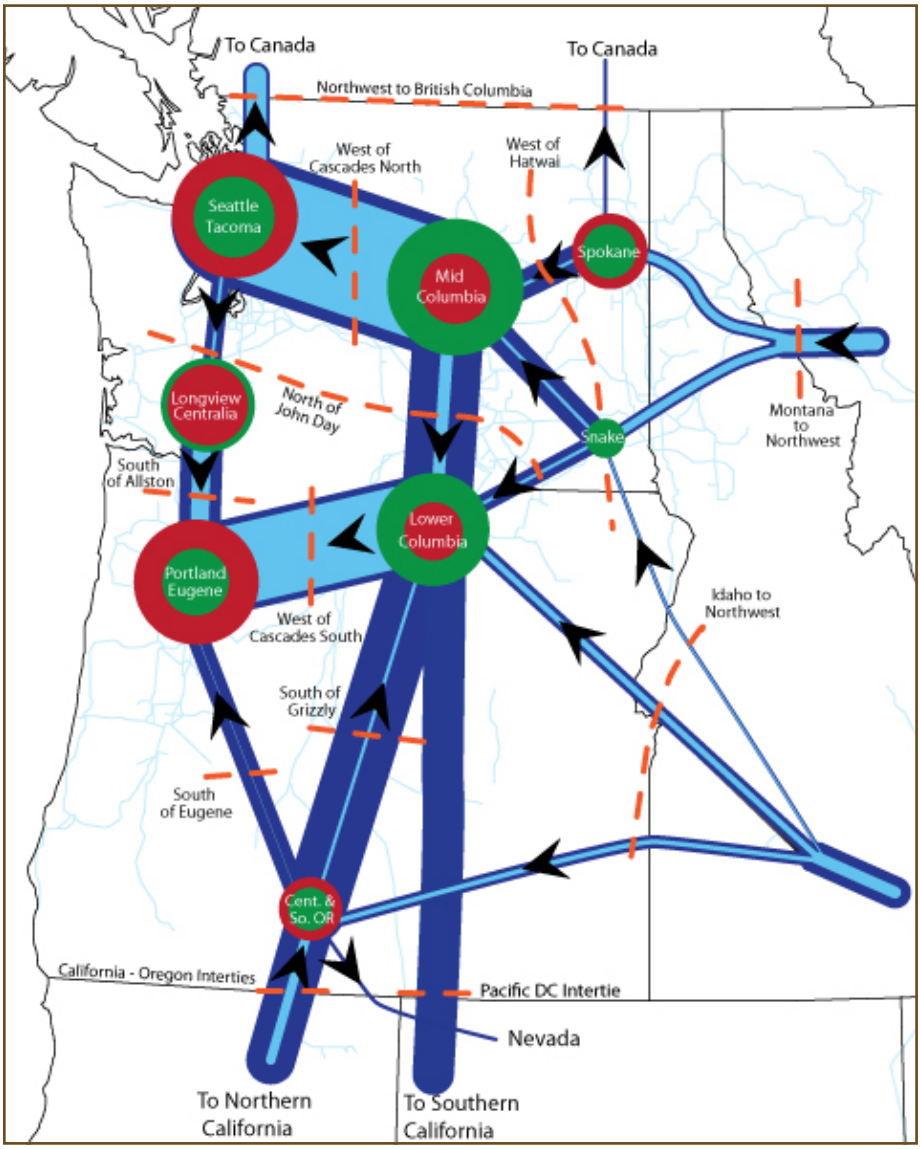
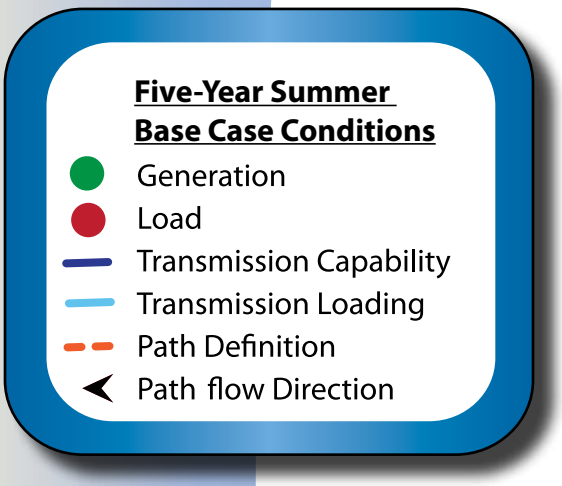


Figure J-3: Five-Year Winter Base Case Conditions

during light-load conditions when eastern loads are down and the excess resources from the east flow into Washington. This path is loaded to -40 MW in the summer and 528 MW in winter. In the outer-year cases, is loaded to 296 MW in the summer and -25 MW in winter with high wind.

6. West of Cascades North and South Paths

The West of Cascades North path is rated at 10,200 MW and the West of Cascades South path is rated at 7,000 MW, both in the east to west direction. These paths are not scheduled paths but transfer east-side resources to the west-side loads. These paths are most stressed during winter load conditions, especially when west-side generation is low. The north path was loaded to 4,695 MW in the five-year summer base case and 8,420 MW in the winter base case. These loadings are 4,706 MW and 7,735 MW, respectively, in the outer-year cases. The south path was loaded to 4,272 MW in the summer base case and 6,003 MW in the winter base case. These loadings are 4,345 MW and 6,850 MW, respectively, in the out-year cases. The increased loading on the South path and the reduced loading of the North path in the winter cases is due to the addition of the Cascade Crossing project which reinforces the southern path.



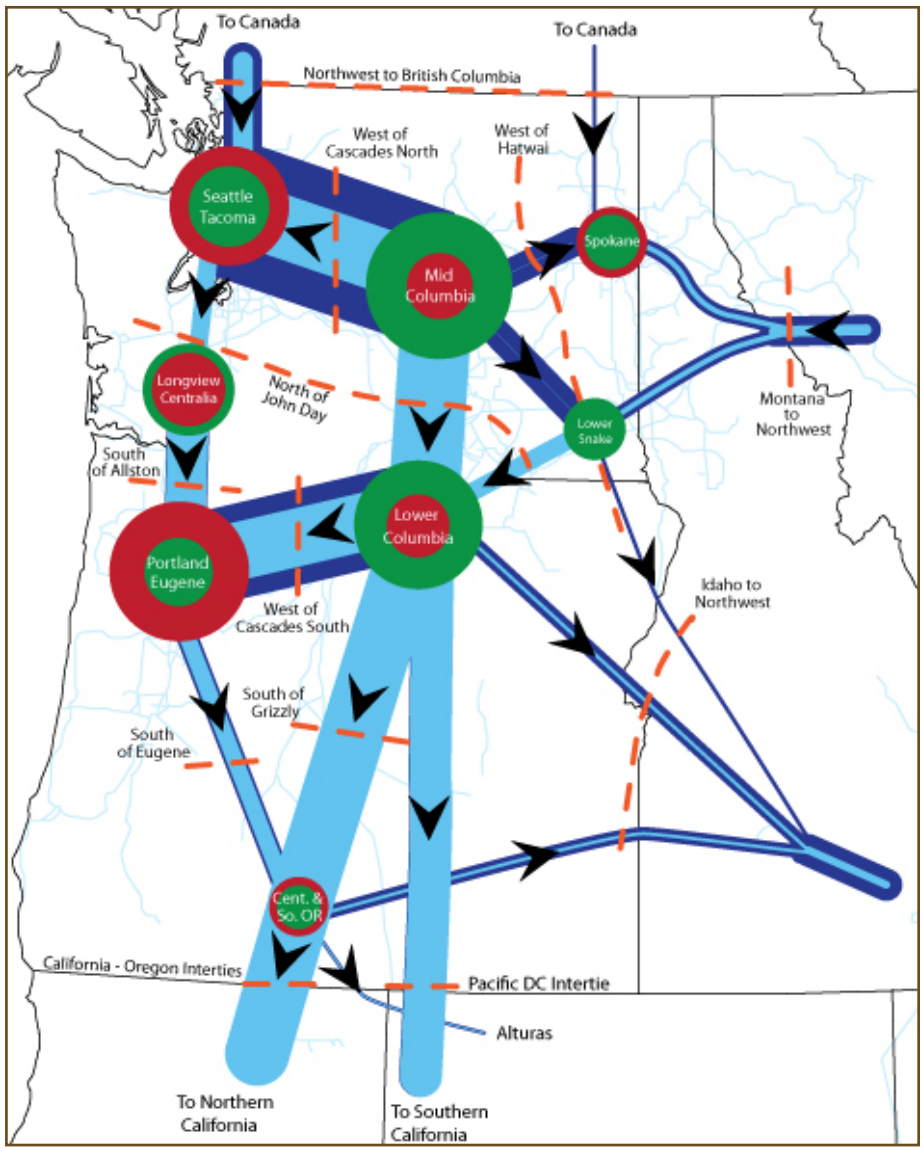


Figure J-4: Five-Year Summer Base Case Conditions

Flow Diagrams

The loads, generation and flows modeled in the base cases are shown in Figures J-1, J-2, J-3 and J-4. The red circles in the figures represent the load levels in the identified areas; the load level is proportional to the area of the circle. The Seattle-Tacoma area includes the area west of the cascades from the Canadian border south through Tacoma. The Longview/Centralia bubble includes the areas south of Tacoma through Longview and west to include the Olympic Peninsula. The Portland/Eugene area includes the Willamette Valley and Vancouver, Washington area. The two major west-side load areas, Seattle/Tacoma and Portland/Eugene, each have approximately 10,000 MW of load in the seven-year winter case as shown in Figure J-1. The Southern/Central Oregon bubble includes the Roseburg area down to the California border and east to the Bend-Redmond area. The Mid-Columbia Area includes load in the Washington area east of the Cascades, west of Spokane, south of the Canadian border and north of the Columbia River. The Lower Columbia bubble includes loads to the south of Mid-Columbia to Central Oregon. The Spokane area includes loads to the east in Western Montana, north to the Canadian border

and south to the Oregon border. The Lower Snake bubble includes the major generation in the area. Figure J-2 shows the ten-year summer conditions; Figure J-3 shows the five-year winter conditions; and Figure J-4 shows the five-year summer conditions.

The area of the green circles represents the amount of generation in that area. The Seattle/Tacoma and Portland/Eugene load areas have more load than generation and rely on other areas to supply the load resource balance. The Mid-Columbia, Lower Columbia and Lower Snake areas have surplus generation that is used in other areas. The Mid-Columbia area has about 11,000 to 12,000 MW of generation represented in the cases. The load/resource ratios in the Spokane, Central/Southern Oregon and Longview/Centralia areas have greater balance.

The dark blue lines between the areas represent the major transmission paths that connect the areas. The width of the dark blue lines represents the relative capacity of the paths. For example, the West of Cascades North path is rated at 10,200 MW. The light blue lines within these paths represent the capacity that is used in the studies. In the winter cases, the West of Cascades paths are heavily used to meet the load levels in the west-side areas while the North of John Day and West of Hatwai paths are lightly loaded. The external paths to Canada, Montana and Idaho are loaded to the firm obligations on each path as discussed earlier. The downstream benefit return loads the Canada to Northwest paths to near their limits. Power is imported from California to provide overall load resource balance in the northwest.

The ten-year summer conditions modeled in the base cases are shown in Figure J-2. The load levels are typically lower in summer than in winter in the west-side areas, and are shown here with proportionally smaller bubbles. Central/Southern Oregon and the east-side areas have summer load levels that exceed the winter. Also note that the Portland/Eugene area load level is greater than Seattle/Tacoma in the summer. These two areas had similar load levels in the winter case. This difference is due to a greater use of air conditioning. The Mid-Columbia and Lower Columbia areas have higher levels of generation in the summer as compared to the winter.

The path usage levels change significantly between summer and winter. In the summer, Canadian hydro generation exceeds the internal loads and excess generation is exported to the northwest and California. The northwest load levels are also lower in summer and there are available resources to export to the south. All of the north-to-south paths load much heavier in the summer due to these flows. The loading on the west of Cascades paths is reduced in summer due to the reduced load level in the west-side. The ties to Idaho are mostly floating with little power moving on that path.

Special Protection System Assumptions

At the transfer levels modeled in the base cases, existing Special Protection Systems are relied on for reliable operation of the transmission system. Some of these Special Protection Systems will effectuate tripping or ramping of generation (some of which have firm transmission rights) for specified single and double line outages. This Special Protection System generation dropping relies on the use

of operating reserves to meet firm transfer requirements (no schedule adjustments are made until the next scheduling period and no firm transfers are curtailed). If the outages are permanent, firm transfers might then need to be curtailed during the next scheduling period to meet the new operating conditions. Firm transmission service commitments are met with this use of Special Protection Systems consistent with NERC and WECC standards.

Transmission Additions Modeled

Since the 2011 Biennial Transmission Expansion Plan, the following projects have been placed in service:

1. Parrish Gap Substation was added on the Bethel-Fry 230 kV line.
2. Horse Ranch - Sedro 230 kV line was completed.
3. Lines into Andrew York Substation were re-terminated.

All of these transmission additions were modeled in the base cases used in the 2011 System Assessment.

Since adding conceptual projects to the assessment could mask future system problems, which is the focus of the System Assessment, potential projects were not included in the base cases. The only future projects that were included in the five-year System Assessment base cases were those where the sponsoring companies had made a firm commitment to build the project within the next five years. These are typically projects that are under construction or that at least have budget approval. By including only projects that are actively being pursued, the next level of needs can easily be identified and prioritized for resolution.

Table J-2 lists the future projects that were included in the System Assessment. These projects are more fully described in Attachment B entitled, "Transmission Expansion Projects". The Lakeside transformer project was originally scheduled for 2015 so it was included in the five year base cases. The latest information from the project sponsor (PSE) indicates that the project may not be completed before 2017.

Several of the larger projects that were included in the base cases are discussed below:

Major Additions in the Five-Year Case

The West of McNary Area Reinforcement Project: This Bonneville project includes two new lines; a McNary-John Day 500 kV line and a Big Eddy-Knight 500 kV line. The project in its entirety includes about 110 miles of new line construction and is proposed to increase the capacity of the West of McNary, West of Slatt, West of John Day and West of Cascades South transmission paths. This would provide additional transmission capability to accommodate transmission service requests in eastern Oregon that are being addressed in the Bonneville Network Open Season process. The McNary-John Day line has been completed and energized. The Big Eddy-Knight line environmental review has been completed and construction has begun. It is expected to be completed in 2013.

The Central Ferry - Lower Monumental 500 kV line: This Bonneville project has been proposed to integrate wind generation projects into the system. The new Central Ferry Substation is located between Little Goose and Lower Monumental Dams. The project would add a new forty-mile 500 kV line from this new substation to Lower Monumental Substation. It is planned to be completed in 2013.

Table J-2: Transmission Projects Included in the Base Cases

Project Name	Sponsor	Date
Mid-Columbia Area Reinforcement (Vantage-Midway 230 kV line upgrade) and 230 kV sectionalizing breakers at Vantage and Midway Substations	Bonneville Power	2011
Second 230/115 kV transformer at Redmond	Bonneville Power	2011
Bakeoven Series Capacitors plus other shunt capacitors and line upgrades (COI Upgrade)	Bonneville Power	2011
John Day - McNary 500 kV Line	Bonneville Power	2012
Big Eddy - Knight 500 kV line looping into the new Knight Substation on the existing Wautoma - Ostrander 500 kV line	Bonneville Power	2013
Central Ferry - Lower Monumental 500 kV line and connection to existing Lower Granite - Lower Monumental 500 kV lines at the new Central Ferry Substation	Bonneville Power	2013
Ponderosa 500/230 kV #2 Transformer Addition	Bonneville Power	2013
Ostrander 500/230 kV transformer addition (replacing McLoughlin transformer, converting Ostrander - McLoughlin 500 kV line to 230 kV operation).	Bonneville Power/PGE	2011
Rebuild the McKenzie - Wenatchee Tap 115 kV line	Chelan County PUD	2011
Rerating of Andrew York - McKenzie 115 kV #1 and #2 lines	Chelan County PUD	2013
Cowlitz PUD conversion from 69 kV to 115 kV (Longview - Cowlitz #2, Longview - Lexington #2, Longview - Lexington - Cardwell)	Cowlitz County PUD	2011-2017
Douglas - Rapids 230 kV line and Rapids 230/115 kV Substation	Douglas County PUD	2013
Columbia - Larson 230 kV line	Grant County PUD	2014
Vantage - Pomona Heights 230 kV line (Yakima area)	PacifiCorp	2013
Parish Gap 230/69 kV Substation connecting to Bethel - Fry 230 kV line (Albany area)	PacifiCorp	complete
Wallula - McNary 230 kV line	PacifiCorp	2012
Whetstone 230/115 kV Substation in Medford area	PacifiCorp	2013
Union Gap 230/115 kV Transformer #3	PacifiCorp	2013
Keeler - Horizon 230 kV line with 230/115 kV transformer at Horizon (Sunset)	Portland General Electric	2012
South of Sedro Capacity Increase (Sedro - Horse Ranch 230 kV Substation)	Puget Sound Energy	2011
230/115 kV transformer at Alderton Substation and new White River - Alderton 230 kV line in south Puget Sound area	Puget Sound Energy	2014
Thurston County Transformer Capacity (230/115 kV transformer at St. Clair Substation with loop through Olympia - South Tacoma 230 kV line)	Puget Sound Energy	2013
Lakeside Substation: Rebuild Sammamish - Lakeside - Talbot 115 kV lines to 230 kV and add 230/115 kV transformer at Lakeside	Puget Sound Energy	2015-2017
Sedro Woolley Substation 230/115 kV transformer addition (#2) in north Puget Sound area	Puget Sound Energy	2012
Beverly Park 230/115 kV transformer (North Puget Sound)	Snohomish County PUD	2013
Cowlitz 230/115 kV transformer replacement (second bank), line retermination, and bus reliability improvement projects	Tacoma Power	2011-2014
Canyon Substation and 230/115 kV transformer (Tacoma area)	Tacoma Power	2011
Projects added only in Seven and Ten Year Base Cases		
Castle Rock - Troutdale 500 kV line (I-5 Corridor Reinforcement Project) connected to the Paul - Allston line at the new Castle Rock Substation. Add double breaker at Pearl 500 500 kV also.	Bonneville Power	2015
Hemingway - Boardman 500 kV line	Idaho Power	2016
Cascade Crossing (Coyote Springs - Boardman - Bethel 500 kV line)	Portland General Electric	2015
Horizon Phase II (Trojan - Horizon 230 kV line)	Portland General Electric	2016
Blue Lake - Gresham 230 kV line	Portland General Electric	2017
Southwest Substation 230 kV bus reliability improvement project (contingency only)	Tacoma Power	2016

Mid-Columbia Area Reinforcements: The transmission plan for the Mid-Columbia area that was developed in the Northwest Transmission Assessment Committee study was included in the assessment. This includes the Bonneville Vantage/Wanapum - Midway 230 kV line reconductor and the PacifiCorp Vantage-Pomona 230 kV line. The preliminary plan for the Northern Mid-Columbia area that has been developed over the last year in the ColumbiaGrid Northern Mid-C Study Team was also included. It includes a Grant County PUD Columbia-Larson 230 kV line; the Douglas PUD Douglas-Rapids 230 kV line, Rapids Substation and 230/115 kV transformer; upgrades to the Chelan County PUD's McKenzie-Wenatchee Tap line and line re-terminations at Chelan's Andrew York Substation. These projects were included in all System Assessment base cases. The Rapids-Columbia 230 kV line is also part of this overall plan but was not added since the project sponsor has not been determined.

Major Additions in the Ten-year cases

The seven and ten-year System Assessment cases also included some additional projects beyond those in the five-year cases. There were a few projects that utilities have committed to build, however, due to significant lead times they are not expected to be completed in the next five years. These additional projects were only included in the seven and ten year cases and are listed below:

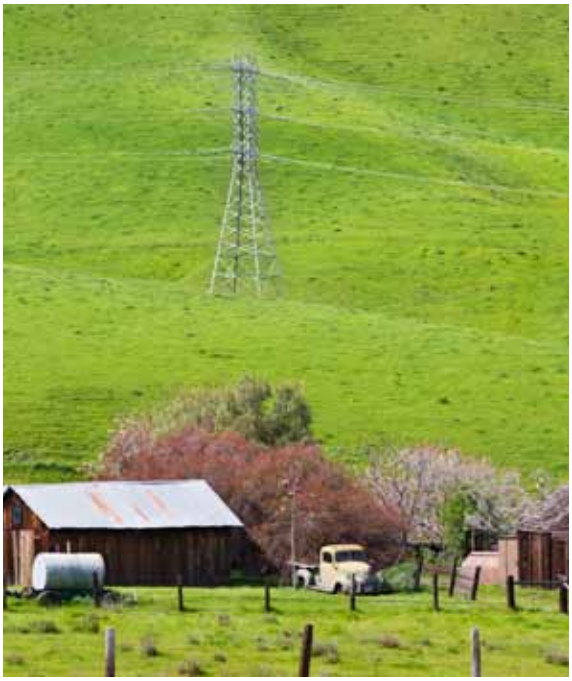
The Hemingway - Boardman 500 kV Project: This Idaho Power, PacifiCorp and Bonneville project includes a 300-mile 500 kV line from the Boise Idaho area to Boardman Substation. This project is intended to provide 1,300 MW of capacity in the west to east directions and 800 MW in the east to west direction. This project is expected to be completed by 2016, pending environmental review.

The I-5 Corridor Reinforcement Project: This Bonneville project consists of a 70-90 mile 500 kV line from a new Castle Rock Substation north of Longview to Troutdale Substation east of Portland. The project is scheduled to be energized in 2016, pending environmental review and is planned to remove the most limiting bottleneck along the I-5 corridor, the South of Allston Cutplane.

Cascade Crossing Transmission Project: The Portland General Electric Cascade Crossing Transmission Project is a 200-mile circuit starting at the Coyote Springs generation plant and terminating into a new 500/230 kV transformer at Bethel Substation. This line will also interconnect at a new Grassland Substation connecting to the Boardman Power Plant and a new Cedar Spring Substation approximately 36 miles southwest of the Boardman where it interconnects with new wind generation. The Proposed Rating of the double circuit project is 2,000 MW and is scheduled for energization in late 2016 or early 2017.

The Horizon Phase II Project: The Portland General Electric Horizon Phase II Project is planned to transfer resources in the Port Westward project into the west Portland area. This project consists of a new 230/115 kV bulk power transformer at Horizon Substation and a new 37-mile Horizon-Trojan 230 kV circuit. This merchant request will provide the capacity needed to integrate 200 MW of proposed generation at the existing Port Westward plant. The target energization date for this project is December 2017.

All transmission facility ratings included in this study were determined by the owner of the facility.



System Assessment Results

The system was analyzed for all base cases without outages (N-0 conditions) and tuned to be within required voltage limits. Any voltage violations or facility overloads that could not be resolved through this tuning were noted.

All single element (N-1 or NERC Category B) outages down to 115 kV were studied on each base case. Participants in the System Assessment provided ColumbiaGrid with information on the multiple contingencies that they wanted to be studied. These included common mode outages, which are plausible outages of multiple facilities caused by a single event, also called NERC Category C events. These common-mode outages are listed in Attachment C of the 2011 System Assessment Report (CEII protected and available only by request). Included in the 2011 System Assessment were inadvertent breaker openings, which are especially important on multi-terminal lines. The System Assessment also included automatic and manual actions associated with each contingency.

Participants were not only asked to review outages of their facilities that caused problems, but also to review any violation of limits on their facilities that were caused by any owner's outage. ColumbiaGrid staff also reviewed the results and participants were allowed to provide a peer review of the results.

Although the focus of the 2011 System Assessment is facilities of the PEFA planning parties, the interconnected nature of the system requires that neighboring facilities also be modeled to determine if there are any interactions between the systems. As mentioned earlier, ColumbiaGrid invited the owners of systems neighboring PEFA parties to participate in the System Assessment.

Five-Year Study Results

There were no loading violations in the five-year base cases with all facilities in-service. All outages that resulted in loadings or voltages outside of criteria were listed in spreadsheets and individually reviewed. Some of the more severe outages did not converge during the initial power flow simulations. Unsolved solutions are an indicator that the voltage stability limit may be exceeded. The Assessment resulted in 12 unsolved solutions in the summer and 18 in the winter. ColumbiaGrid has completed work on the analysis of these issues and include mitigation projects in the Sensitivity section of this Expansion Plan Update.

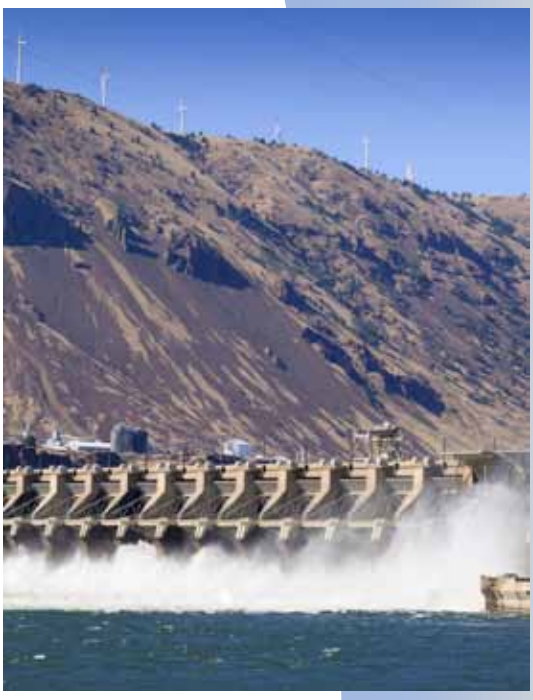
The System Assessment identified 67 line sections in the 2016 heavy winter case operated at 115 kV that overloaded during various outage conditions where mitigation was not identified. Of these overloaded lines, 23 are owned by ColumbiaGrid planning participants. A total of 271 line sections overloaded in the 2016 heavy summer case where mitigation was not identified; 173 of these overloaded lines are owned by ColumbiaGrid planning participants. No specific mitigation was identified in the five-year studies. Although many types of mitigation would be possible in that timeframe, this study concentrated on mitigation for the seven and ten-year studies (below).

Seven and Ten-Year Study Results

Contingencies were studied on the ten-year summer and seven-year winter cases in the same manner as the five-year cases. Additional problems were noted in these studies. As noted above, the ten-year studies also included the I-5 Corridor Reinforcement Project, the Hemingway-Boardman Project, Cascade Crossing Project and the Horizon Phase II Project. All areas were within normal limits in the ten-year base cases except the West 230/115 kV transformers in the Spokane area and the Horn Rapid-Red Mountain 115 kV line in the Tri-Cities. These facilities also experienced increased overloads for outage conditions.

The System Assessment identified 194 line sections in the 2018 heavy winter case operated at 115 kV that overloaded during various outage conditions where mitigation was not identified. Of these overloaded lines, 139 are owned by ColumbiaGrid planning participants. A total of 179 line sections overloaded in the 2021 heavy summer case where mitigation was not identified; 79 of these overloaded lines are owned by ColumbiaGrid planning participants. It was assumed that these line sections could be rerated, reconductored, or rebuilt as mitigation and these types of projects are considered "placeholder" projects until more thorough reviews can be completed by the affected parties and specific transmission projects can be identified. These Assessment cases also resulted in 8 unsolved power flow solutions in the summer and 21 unsolved solutions in the winter. ColumbiaGrid has completed work on the analysis of these issues and include mitigation projects in the Sensitivity section of this Expansion Plan Update.

All contingencies were first run without mitigation and all violations noted. Participants in the System Assessment provided ColumbiaGrid with descriptions of mitigating actions for some contingencies that the participants have been planning.



Mitigating actions include operator actions such as opening or closing lines, or adjusting generation, as well as infrastructure upgrades like reconductoring, line additions, or bus reconfigurations. Contingencies with potential mitigation were then re-examined. For each contingency with mitigation, changes to the contingency definition were made only if violations occurred in the first run. In the out-year cases, both operator actions and upgrade projects were modeled in the mitigation cases.

The failed solutions listed above are areas likely to have voltage stability issues that will require follow-up sensitivity studies to determine the cause and mitigation of the failed solutions. ColumbiaGrid has completed work on the analysis of these issues and include mitigation projects in the Sensitivity section of this Expansion Plan Update. These contingencies involve eleven areas of the system:

•The Port Angeles area in northwestern Washington

•The Shelton area in the southeastern Olympic Peninsula

•The Centralia area in southwestern Washington

•The Santiam area in East Salem

•The Fairview area in western Oregon

•The Grants Pass areas in southwest Oregon

•The Redmond-Bend area

•The Alturas area in northern California

•The Kalispell area in Montana

•The McKenzie area in Wenatchee

•The Columbia Gorge area (Bonneville and The Dalles)

Most of these areas showed up in previous assessments. The last two areas listed are different from last year. The Wenatchee area problems may be modeling issues. The Gorge problems in the Bonneville and The Dalles area were new this year and may be related to wind generation in the area. All of these areas are explored further in the sensitivity studies.

Voltage problems were addressed similarly to overloading issues except that the interim corrective action was assumed to be

Substation (all 230 kV)	MVARs	Owner
Dixonville	20	PacifiCorp
Flathead	15	Bonneville
Garrison	40	Bonneville
Grants Pass	25	PacifiCorp
Martin Tap	10	Bonneville
Pilot Butte	70	PacifiCorp
Roundup	10	Bonneville
South Bremerton	15	Puget Sound Energy
Salem	10	Bonneville
Santiam	75	Bonneville
Tillamook	10	Bonneville
West	20	Avista
Total	**320**	

Table K-1: Potential Reactive Mitigation Projects

capacitor additions rather than rerating, reconductoring, or rebuilding lines. In identifying the need for capacitor additions, the standard WECC criteria of no more than a 5% voltage drop following a credible Category B (single) contingency or a 10% voltage drop following a credible Category C (multiple) contingency was used.

The reactive requirements to prevent these voltage violations were studied for the 230 kV and 500 kV systems. The reactive additions necessary to mitigate voltage problems for the ten-year planning horizon total 320 Mvars of shunt capacitance in 12 different locations, all at the 230 kV level. These additions are listed in Table K- 1.

These voltage results will be used as the basis for further transmission owner or study team technical studies. Only voltage violations on facilities 230 kV and above were addressed with capacitor additions since these systems usually impact multiple transmission systems. Correcting voltage issues on lower voltage transmission facilities was left to the individual transmission owners, as there is ample time to identify and implement these additions.

All base cases included both generation units at Centralia. As mentioned earlier, the state of Washington has come to an agreement with the owner of the Centralia Power Plant that one 700 MW coal-fired unit will be retired in 2020 and the second unit in 2025. To cover the other scenario that could occur in the planning horizon with one unit retired and out of service, a sensitivity was run on the ten-year summer case with one Centralia unit off line and the generation replaced at Grand Coulee. The overloads for this scenario were compared against the normal base case with both units in service. Changes greater than 3% were noted. The majority of these changes were problem areas east of the Cascade Mountains already noted in other studies. The increased loadings were due to the change in Coulee generation. Only one problem showed up in the west around the Centralia plan, on the Midway P-Zenith line. This problem was also noted in the Centralia Closure Study. This sensitivity did not uncover

any new transmission issues. These study results were included in Attachment C of the 2011 System Assessment (CEII protected).

Joint Areas of Concern

Joint areas of concern (those that occurred between systems) are the primary focus of ColumbiaGrid's System Assessment. These areas were identified when multiple planning parties had outages that caused overloads and/or had facilities that overloaded as a result of such outages. ColumbiaGrid will organize study teams as necessary to resolve these system deficiencies between ColumbiaGrid members.

If a problem did not involve multiple utilities, it was considered to be a single-system issue and remained the responsibility of the individual owner. The only obligation in this instance is for the owner to report back to the ColumbiaGrid process on the measures they have planned to mitigate the single-system problem. ColumbiaGrid will use these mitigation plans to update its future base cases.

The following areas were identified in the 2011 System Assessment in the ten-year planning horizon and involve more than one system. Several of these will require further study over the remainder of the year to determine the extent of the system problems and to develop mitigation. A more detailed summary of these problem areas is further described in the Transmission Issues portion of Attachment C: Supporting Data in the 2011 System Assessment (CEII protected).

1. Northern Olympic Peninsula: Voltage instability and overloads in the Fairmont and Port Angeles area occurred for loss of the Shelton-Fairmount 230 kV #1 and #2 lines which are on double circuit towers in both winter cases. This transmission issue has been identified in previous System Assessments. A safety net scheme to drop local load for this outage and prevent widespread load loss along with substation improvements at Port Angeles has been proposed by Bonneville. These voltage stability issues were studied further as described in the Sensitivity Studies section of this report.

2. The Olympia-Shelton Area: An outage of certain 230 kV Shelton bus sections could cause voltage stability issues in the area in winter conditions. This transmission issue was identified in previous System Assessments and Puget Sound Energy and Bonneville are working together to decide the best way to proceed with resolution of this issue. These voltage stability issues were studied further as described in the Sensitivity Studies section of this report.

3. Puget Sound 500/230 kV Transformation: The Covington 500/230 kV transformer overloads for N-2 outages in the Raver-Covington-Tacoma and Echo Lake-Maple Valley areas during winter peak load conditions. These overloads are much higher in the 2011 System Assessment than prior assessments. Mitigation for this problem is under active consideration and study in the Puget Sound Area Study Team.

4. Centralia Area: Outages of the N-2 Paul-Olympia/Paul-Satsop 500 kV lines has voltage stability issues and overloads the Paul-Tono

phase shifter in the winter cases. This problem was not identified in prior assessments and is the responsibility of Bonneville and PSE to resolve. These voltage stability issues were studied further as described in the Sensitivity Studies section of this report.

5. Interaction of Proposed Cascade Crossing Project: N-2 outages of the 500 kV lines between Salem and Eugene (Marion-Alvey and Marion-Lane), outages of the Santiam and Alvey 230 kV busses and several other lower voltage outages cause overloads in the Salem-Eugene area in the outer year cases when the proposed Cascade Crossing project is modeled. Since these overloads did not occur in the earlier cases without the project and since these loadings are significantly higher with the project, interaction with the Cascade Crossing Project is likely. Further project coordination will be needed as the Cascade Crossing project is developed.

6. Interaction of Proposed I-5 Corridor Project: BPA is planning to build the I-5 Corridor project which is a line from the new Castle Rock Substation to Troutdale Substation. PGE is also planning to reinforce their system between Troutdale and Gresham by building a Blue Lake-Gresham 230 kV line. Both of these projects appear to correct the problems they were designed to mitigate, however there is an interaction between these two projects that creates some new transmission issues. The single Gresham-Linneman 230 kV line and the N-2 Gresham-Troutdale/Linneman-Troutdale 230 kV outages cause the Blue Lake-Troutdale 230 kV and Blue Lake-Gresham 230 kV lines to overload. There are also 230/115 kV transformer overloads in the area for various N-1 line outages. These overloads only occur with both the Blue Lake-Gresham and I-5 Corridor Projects energized in the longer term cases. Further project coordination will be needed as these two projects are developed.

7. Pearl-Sherwood Area: Several 230 kV lines in the McLoughlin-Pearl-Sherwood area overload for parallel outages in the winter cases. Also, McLoughlin and Sherwood 230/115 kV transformers overload for these same 230 kV line outages. PGE and BPA are planning a reconfiguration project between Pearl and Sherwood to resolve this issue and the timing of this project is dependent on forecasted load in this area.

8. Salem-Eugene area: Outages of the Santiam-Wren 230 kV line or the Santiam 230 kV bus section breaker could cause voltage stability issues in the Salem-Eugene area. These problems involve outages of BPA facilities and could cause problems for Bonneville, Portland General Electric and PacifiCorp equipment. These voltage stability issues were studied further as described in the Sensitivity Studies section of this report.

9. Bend Area Voltage Stability: Loss of the N-2 outage of Pilot Butte-Redmond/ Pilot Butte-Ponderosa 230 kV lines causes potential voltage stability in the Bend area in all base cases, summer and winter. This is an issue for BPA and PacifiCorp to resolve. These voltage stability issues were studied further as described in the Sensitivity Studies section of this report.

10. Benton AVA-Taunton-South Othello 115 kV overloads: Several outages around Larson, Frenchman Hills and Warden cause

the Benton AVA-Taunton-South Othello 115 kV line to overload in the seven-year winter and both summer cases. Several utilities own facilities in the vicinity of the overloaded line. Avista is looking at reconductor options to resolve this issue. This issue showed up in previous System Assessments and has been proposed to be coordinated in the Northern Mid-C Study Team.

11. Spokane area 230/115 kV transformation: Avista's Westside 230/115 kV transformer is overloaded in the summer base cases. Bonneville's Bell 230/115 kV transformer and Avista's Beacon transformer overload for outages of the parallel Bell and Beacon 230/115 kV transformers and the Beacon South 230 kV bus in all base cases. This issue was identified in previous System Assessments and is a problem that Avista and BPA are working to mitigate.

12. Moscow Area: The Moscow 230/115 kV transformer overloads for Hatwai 500 and 230 kV bus outages, the Beacon and Bell 230 kV bus outages and the Shawnee and Beacon 230/115 kV transformers in all cases. These facilities are owned by Bonneville and Avista. This is a problem that is being addressed by Avista.

13. Sandpoint Idaho Area: Libby 230/115 kV transformer outages and Libby 115 kV bus outages overload facilities out of Cabinet Gorge Substation in the ten-year summer case. These facilities are owned by Bonneville and Avista. Similar issues were identified in previous System Assessments and Bonneville and Avista have proposed sectionalizing the system at Sand Creek to mitigate this problem.

The final screening results of all solved outages are included in the spreadsheet in Attachment C of the 2011 System Assessment; however, this is CEII protected information and can only be obtained by request. This spreadsheet includes results for each facility that overloaded for outages studied during the 2011 System Assessment. The spreadsheet shows separate results for the five-year summer and winter base cases, the seven-year winter base case and the ten-year summer case.

Attachment A: Resource Assumptions for Base Cases (MW Output)

Resource Name	2016 Heavy Winter	2016 Heavy Summer	2018 Heavy Winter	2021 Heavy Summer
Albeni Falls	42	42	41	42
Alder	34	20	20	20
Beaver	465	464	465	464
Big Cliff	19	0	0	0
Big Hanaford	256	0	252	256
Biomass	10	10	10	10
Boardman	612	612	612	1,042
Bonneville	633	743	335	742
Boulder	24	0	0	0
Boundary	870	608	748	607
Box Canyon	58	58	57	58
Boyle	80	80	79	80
Bull Run	13	3	13	3
Cabinet Gorge	126	116	115	116
Camas Mill	23	23	23	30
Carmen	88	41	81	41
Cedar Falls	30	4	11	4
Centralia	1,490	1,490	1,469	1,490
Chehalis	520	520	513	520
Chelan	62	62	62	62
Chief Jo	2,115	2,390	947	2,388
Clearwater AVA	98	64	50	64
Clearwater PAC	41	41	40	41
Columbia Generating Station	1,155	1,155	1,110	1,155
Copco	20	20	30	20
Cougar	13	13	12	13
Coulee	5,294	5,861	3,751	5,511
Cowlitz Falls	34	17	17	17
Cowlitz	34	34	33	34
Coyote Springs	468	440	468	440
Cushman	18	45	114	45
Detroit	52	104	102	104
Diablo	157	59	143	59
Dworshak	92	184	181	184
Electron Heights	12	12	12	12
Enserch	156	156	174	156
Faraday	32	11	32	11
Finley	0	0	28	0
Foster	7	7	14	7
Frederickson CCCT	250	250	247	250
Frederickson	149	149	160	149
Fredonia	316	308	312	308
Glenoma	29	29	29	29

Resource Name	2016 Heavy Winter	2016 Heavy Summer	2018 Heavy Winter	2021 Heavy Summer
Goldendale Energy Center	250	250	247	250
Gorge	165	60	138	60
Grays Harbor	630	0	631	640
Green Peter	48	8	8	8
Headwork	0	20	0	20
Hermiston Gen Project	430	430	424	430
Hermiston Power Project	559	559	551	559
Hills Creek	30	30	30	30
Hungry Horse	95	190	187	190
Ice Harbor	408	360	223	473
Jackson	124	60	60	60
John Day	1,390	2,087	383	2,085
Kettle Falls	43	43	43	43
Kimberly-Clark	27	28	28	28
Klamath	585	585	577	420
Lagrande	45	25	39	25
Lancaster	250	250	246	250
Lemolo	62	29	29	62
Libby	324	216	213	432
Little Falls	32	15	32	15
Little Goose	278	707	411	706
Longlake	84	36	84	36
Longview	40	40	39	40
Lookout Point	25	25	74	25
Lost Creek	30	30	30	30
Lower Baker	72	60	73	60
Lower Granite	278	707	411	706
Lower Monumental	278	707	376	706
March Point	138	138	147	138
Mayfield	140	99	130	99
McNary	792	461	630	460
Merwin	90	30	89	30
Mint Farm	235	235	231	235
Morro	0	0	23	0
Mossy Rock	320	320	300	320
Nine Mile	11	12	9	12
North Fork	33	9	33	9
Northeast	0	0	0	0
Noxon	320	320	300	320
Oak Grove	32	20	32	20
Pelton	120	85	120	85
Port Angeles	0	0	28	0
Port Westward	399	378	399	378
Priest Rapids	686	681	837	680

Resource Name	2016 Heavy Winter	2016 Heavy Summer	2018 Heavy Winter	2021 Heavy Summer
Prospect	28	44	43	44
Rathdrum	66	133	0	133
River Road	235	235	232	235
Rivermill	14	5	14	5
Rock Island	373	416	223	415
Rocky Reach	800	1,177	581	1,175
Ross	274	97	127	97
Round Butte	270	161	270	161
Sawmill	25	25	25	25
Simpson	64	64	44	64
Smith Falls	0	0	36	0
Snoqualmie Falls	31	31	30	31
Spokane Waste	20	20	18	20
Sullivan	15	14	15	14
Sumas	116	116	128	116
Summer Falls	0	100	0	100
Swift	210	210	207	210
Tenaska	246	246	263	246
The Dalles	1,215	1,561	670	1,560
Toketee	43	43	42	43
Twin Falls	0	10	0	10
Upper Baker	68	68	102	68
Wanapum	744	931	656	930
Wauna	32	32	31	32
Wells Gen	720	721	559	720
Western Kraft	91	91	10	91
Weyerhauser (EWEB)	37	37	36	37
Whitehorn	74	149	160	149
Yale	100	100	66	100
Wind Generation				
Big Horn Wind	0	0	200	0
Biglow Canyon Wind	0	0	320	0
Combine Hills Wind	0	0	104	0
Condon Wind	0	0	50	0
Dodge Jct Wind	0	0	191	0
FPL_II_LT Wind	0	0	99	0
Goldendale Wind	0	0	201	0
Goodnoe Hills Wind	0	0	150	0
H Canyon Wind	0	0	100	0
Harvest Wind	0	0	64	0
Hopkins Ridge Wind	0	0	150	0
Juniper Creek Wind	0	0	150	0
Kittitas Valley Wind	0	0	0	0

Resource Name	2016 Heavy Winter	2016 Heavy Summer	2018 Heavy Winter	2021 Heavy Summer
Klondike Wind	0	0	297	0
Leaning Juniper Wind	0	0	300	0
Linden Wind	0	0	50	0
Marengo Wind	0	0	110	0
Miller Ranch	0	0	45	0
Nine Canyon Wind	0	0	96	0
Nine Mile Wind	0	0	95	0
Pebble Springs Wind	0	0	100	0
PHLNG Wind	0	0	152	0
Rattlesnake Wind	0	0	75	0
Saddleback Wind	0	0	70	0
Shepards Flat Wind	0	0	856	0
Stateline Wind	0	0	210	0
STRPT Wind	0	0	101	0
TULMN Wind	0	0	137	0
Vansycle Wind	0	0	227	0
WEBFT Wind	0	0	101	0
White Creek Wind	0	0	239	0
WHT F Wind	0	0	100	0
Wild Horse Wind	0	0	272	0
Willow Creek Wind	0	0	100	0
Windy Flat Wind	0	0	312	0
Totals (MW)	**31,801**	**33,357**	**26,341**	**34,514**

Attachment B: Transmission Expansion Projects

Olympic Peninsula Projects

Project Name	Description	Sponsor	Parties Impacted by Project	Link to More Detail	Project Stage	Project Commitment Level	Scheduled Completion
Olympia 230/115 kV Transformer Bank No.3	Add a new 230/115 kV Transformer at Olympia Substation	BPA			Conceptual Project for future need		2021
Shelton-Fairmount-Port Angeles Area	Shelton-Fairmount 230 kV line No. 4 & 5 Construct a new double circuit 230 kV line (approximately 60 miles) between Shelton and Fairmount Substations.	BPA			Conceptual Project for future need		2022
Fairmount-Port Angeles #2 230 kV line	Upgrade Fairmount-Port Angeles #2 230 kV line	BPA			Conceptual Project for future need	Only if non-wires project fails	
Port Angeles 230 kV bus and Transformer	Develop breaker and half 230 kV yard at Port Angeles and add second 230/69 kV transformer	BPA			Funded	Only if non-wires project fails	2014
North of Shelton Back-tripping Safety Net	Back-Tripping scheme to open Fairmount-Port Angeles 230 kV lines for double line outage of Shelton-Fairmount 230 kV lines (non-wires solution)	BPA	PSE		Funded		2013
Olympia-Shelton 230 kV line #5	Reconductor 7.25 miles of Olympia-Shelton #5 line from Olympia to Olympia-Satsop corridor with Deschutes conductor	BPA			Conceptual Project for future need		
Kitsap-South Bremerton 115 kV line	Construct second Kitsap-South Bremerton 115 kV line or PSE Foss Corner options	BPA	PSE		Conceptual Project for future need		
Jefferson County 115 kV Upgrade Phase 2	Loop Port Townsend Mill 115 kV line into Irondale	PSE			Cancelled		
West Kitsap Transmission Project Phase II	Installation of 230/115 kV transformer at Foss Corner Substation along with a 230 kV line from Foss Corner to the future BPA Kitsap 230 kV Substation	PSE	BPA		Conceptual Project for future need		2018
Kitsap 230 kV yard	Develop breaker and half 230 kV yard at Kitsap for Shelton-South Bremerton and Kitsap-Foss Corner lines.	BPA	PSE		Conceptual Project for future need		

Cost Estimate	Project Need/Driver & Other Notes	Changes from Previous Plan	Plan cross tribal lands	Type of Project	Study Team(s)
$7 M	Load growth	Delayed from 2017		Single System Project with possible impacts	
$21.5 M	Load growth			Single System Project	
	Load growth			Single System Project	
$15 M	Load growth and System Reliability			Single System Project	
$0.5 M	Load growth	Delayed from 2012		Single System Project	
	Load growth			Single System Project	
	Load growth			Single System Project	
	Back up transmission to Jefferson County	PSE no longer serving this area		Single System Project	
	Provide additional capacity to serve projected load growth in Kitsap County			Single System Project with possible impacts	
	Load growth			Single System Project	

Puget Sound Projects

Project Name	Description	Sponsor	Parties Impacted by Project	Link to More Detail	Project Stage	Project Commitment Level	Scheduled Completion
Cowlitz Substation 230 kV Line Re-termination Project.	This project involves the re-termination of BPA's South Tacoma-Cowlitz (#1) 230 kV line from TPWR's Cowlitz 230 kV Bus into TPWR's Southwest (#4) line. It also includes the re-termination of TPWR's Cowlitz-Southwest (#3) and Cowlitz-Tacoma (#2) 230 kV lines to create a new Southwest-Tacoma 230 kV line.	Tacoma Power	BPA		Study completed by BPA in June 2008		2012
Pierce County transformer capacity.	A new 230/115 kV transformer at Alderton Substation in central Pierce County with new 230 kV line from White River.	PSE			Plan of Service determined	Included in sponsor's budget	2014
Thurston County transformer capacity.	A new 230/115 kV transformer at Saint Clair Substation in Thurston County with a looped transmission interconnection to BPA Olympia - South Tacoma 230 kV line.	PSE			Plan of Service determined	Included in sponsor's budget	2013
Denny Substation	Proposed new 180 MVA substation in the north of downtown Seattle area.	Seattle City Light			Preliminary Design	Preparing Budget Documents	2016
South of Sedro Capacity Increase	Rebuild a 115 kV line to become a second 230 kV line between Sedro Woolley and Horse Ranch Substations. Includes reconductoring sections of the Sedro Woolley-Horse Ranch-Bothell 230 kV line, adding 2 breakers at Horse Ranch, and uprating the Horse Ranch-HR Tap of the portion of Monroe-Snohomish 230 kV line	PSE	in parallel w/ BPA & Snohomish PUD w/ impacts to the Westside Northern Intertie		Completed		Completed
Southwest Substation 230 kV Bus Reliability Improvement Project	Modify Bus section breaker arrangement at Southwest Substation to eliminate single point of failure of bus section breaker.	Tacoma Power					2013-14
Beverly Park 230/115 kV Capacity Addition	Expand the existing 115 kV switching station and add 230/115 kV 300 MVA transformer at Beverly Park. An existing 115 kV line from BPA Snohomish to the Glenwood Tap will be converted to 230 kV to provide the source for this substation.	Snohomish County PUD	Additional BPA Snohomish 230 kV bus positions are required		Project is in the design and construction Phase		2014
Canyon Substation	Tacoma Power proposed to interconnect the new Canyon substation to BPA's South Tacoma Substation. A single 230/110 kV step down transformer will be installed at this substation in the near term with provisions made for a future second transformer.	Tacoma Power	BPA		Completed	High	Energized
IP line conversion to 230 kV	Convert PSE's 115 kV "IP" line to 230 kV between Wind Ridge Substation and Lake Tradition Substation in King County to increase cross-Cascade capacity and interconnect Kittitas County wind projects	PSE	PSE		Conceptual Project for future need		2020+
North Cross Cascades Reinforcement	This project includes adding 500 kV series capacitors (30-40%) to the Schultz-Raver 500 kV lines No.3 & 4 to serve growing loads in the Puget Sound area	BPA	PSE		Conceptual Project for future need		2017
Seattle Area 500/230 kV Transformer Bank	Add a 500/230 kV transformer at Raver and a 230 kV terminal at Raver for a Raver-Covington 230 kV line.	BPA	PSE, SCL		Project identified in PSAST Expansion Plan	Utilities negotiating cost allocation	2016
Cowlitz Substation 230 kV Bus Reliability Improvement Project.	Modify bus section breaker arrangement at Cowlitz Substation to eliminate single point of failure of bus section breaker.	Tacoma Power					2015-16
Cowlitz 230 kV Transformer Replacement	Replace the two 250 MVA transformers at Cowlitz Substations with two 400 MVA, 230/115 kV, transformers.	Tacoma Power			Complete		Energized

Cost Estimate	Project Need/Driver & Other Notes	Changes from Previous Plan	Plan cross tribal lands	Type of Project	Study Team(s)
$750K to $1M	Reliability improvement			Single System Project, possible impacts	Puget Sound Area Study Team
$28 M	Load service, Capacity Increase, Reliability	Delayed from 2012 to 2014		Single System Project, possible impacts	Puget Sound Area Study Team
$27.5 M	Load service, Capacity Increase, Reliability			Single System Project, possible impacts	Puget Sound Area Study Team
$150 M	Load service and System Reliability	was called North Downtown Substation		Single-System project possible impacts	Puget Sound Area Study Team
$38.8 M	Capacity Increase	Completed		Capacity Increase Project	Puget Sound Area Study Team
$3 M	The purpose of this project is to improve system reliability by preventing any bus fault or a stuck breaker on one of the 230 kV buses from resulting in total loss of service to the substation.	Moved up from 2016		Single System Project	Puget Sound Area Study Team
$25 M	Load growth and expected local reliability deficiency in Paine Field and Everett areas requires capacity increases to meet District level of service guidelines	Delayed from 2012		Single System Project, possible impacts	Puget Sound Area Study Team
$10 M	Improve system reliability and operational flexibility, accommodate load growth in the area.	Completed		Single System Project, possible impacts	Puget Sound Area Study Team
	Load growth in Puget Sound and generation integration, related to North Cross Cascades Improvements			Capacity Increase Project	West of Cascades Study Team
$30 M	Load growth in Puget Sound and Transmission Service Requests			Existing Obligation Project	West of Cascades Study Team
$50 M	Load growth in Puget Sound area	Transformer location changed from Covington to Raver		Existing Obligation Project	Puget Sound Area Study Team
	The purpose of this project is to increase system reliability and operational flexibility	This project was delayed from 2013-14 to 2015-16		Single System Project	
	System load growth and operational flexibility and higher reliability.	Complete		Single System Project	

Puget Sound Projects continued

Project Name	Description	Sponsor	Parties Impacted by Project	Link to More Detail	Project Stage	Project Commitment Level	Scheduled Completion
Swamp Creek 115 kV Switching Station	Construct a six 115 kV breaker switching station with a ring bus arrangement. This switching station will terminate 115 kV lines from SnoKing (2 Lines), Halls Lake (1 line) and from Beverly Park (1 line).	Snohomish County PUD			Project under study		2021
Paine Field 115 kV Switching Station	This project includes the addition of a six 115 kV breaker ring bus adjacent to the existing Paine Field Substation. The switching station will terminate lines from Paine Field, Mukilteo, Olivia Park, Boeing, Gibson, Beverly Park via Casino (new), and Swamp Creek via Picnic Point tap (new).	Snohomish County PUD			Project under study		2021
Swamp Creek to Picnic Point Tap 115 kV Line	Construct a 115 kV line (2.9 miles) with 1272 kCM conductor from Swamp Creek Substation to the Picnic Point tap. A new 115 kV line position and breaker will be added to the Swamp Creek 115 kV Switching Station. The Picnic Point Tap to the Picnic Point Substation 115 kV Line will be operated normally opened.	Snohomish County PUD			Project under study		2020
Marysville 230/115 kV Substation	Construct a new 230/115 kV 300 MVA substation in the Marysville, Washington area. The existing BPA Murray-Snohomish 230 kV line will be looped into the new station. The new substation will consist of four 115 kV line positions connected to the existing area 115 kV network.	Snohomish County PUD	BPA		Project under study		2025
Beverly Park and South Snohomish County 115 kV Expansion	Beverly Park-Boeing 115 kV line reconductor and Beverly Park-Everett 115 kV line capacity increase.	Snohomish County PUD			Design and Construction		2014
East King County Transformer Capacity (Lake Tradition)	This project involves looping the Maple Valley-Sammamish #1 230 kV line into PSE's Lake Tradition Substation and installing a new 230/115 kV transformer.	PSE	BPA - loop through of BPA owned and PSE leased 230 kV line		Conceptual		2017+
Skagit County Transformer Capacity	This project involves installing an additional 230/115 kV transformer into PSE's Sedro Woolley Substation.	PSE			Project identified as future need		2012
Monroe Substation Improvements	Monroe 500 kV 316 MVAR Shunt capacitor bank	BPA				Committed	2014
East King County Transformer Capacity	Rebuild the Sammamish-Lakeside-Talbot 115 kV lines and energize one at 230 kV and install a new 230/115 kV transformer at Lakeside.	PSE	BPA, SCL, Northern Intertie		Project identified in PSAST Expansion Plan	Utilities negotiating cost allocation	2015 - 2017
Expand Northern Intertie RAS	Extend the Northern Intertie RAS to trip for the combined outage of the Chief Joseph-Monroe and Monroe-SnoKing-Echo Lake 500 kV lines	BPA			Project identified in PSAST Expansion Plan	Utilities negotiating cost allocation	2016
Reconductor Delridge-Duwamish 230 kV line	Reconductor Delridge - Duwamish 230 kV Line with high temperature conductor	SCL	BPA, PSE		Project identified in PSAST Expansion Plan	Utilities negotiating cost allocation	2016
Downtown Seattle Series Inductors	Add 6 ohm inductors in Broadstreet - East Pine and Broadstreet - Union - Massachusetts 115 kV underground cables	SCL	BPA, PSE, Sno PUD		Project identified in PSAST Expansion Plan	Utilities negotiating cost allocation	2016
Reconductor Bothell-Snoking 230 kV lines	Reconductor Bothell-SnoKing 230 kV #1 and #2 with high temperature conductor	SCL	BPA, PSE		Project identified in PSAST Expansion Plan	Utilities negotiating cost allocation	2016
Portal Way Substation - Install 2nd 230-115 kV Transformer	Construct a new 230 kV line from BPA Custer Substation to PSE Portal Way Substation. Install a 230-115 kV, 325 MVA transformer, and install another 115 kV bus section breaker in Portal Way Substation	PSE	BPA, PSE, Northern Intertie		Project identified in PSAST Expansion Plan	Utilities negotiating cost allocation	2015-2016
Sedro-Woolley-Bellingham #4 115 kV line	Reconductoring Sedro-Woolley-Bellingham #4 115 kV line	PSE			Design and Construction	Included in sponsors budget	2015
PSE Bellingham Substation Rebuild	Construct a new breaker and a half 115 kV substation	PSE			Project under study	Project identified as future need	2016

Cost Estimate	Project Need/Driver & Other Notes	Changes from Previous Plan	Plan cross tribal lands	Type of Project	Study Team(s)
	South County area load growth and expected reliability deficiencies. This is part of a multi-project effort to provide three 115 kV ties between BPA SnoKing and BPA Snohomish Substations.			Single System Project	
	South County area load growth and expected reliability deficiencies. This is part of a multi-project effort to provide three 115 kV ties between BPA SnoKing and BPA Snohomish Substations.			Single System Project	
	South County area load growth and expected reliability deficiencies. This is part of a multi-project effort to provide three 115 kV ties between BPA SnoKing and BPA Snohomish Substations.			Single System Project	
	Marysville area load growth and expected North County reliability deficiencies			Single System Project, possible impacts	
	Beverly Park and South Everett area load growth and expected local reliability deficiencies	Delayed from 2012		Single System Project	
$13 M	Load service, Capacity Increase, Reliability	Schedule moved out assuming Lakeside project is successful		Single System Project, possible impacts	Puget Sound and Northern Mid-C Area Study Teams
$9.4 M	Load service, Capacity Increase, Reliability			Single System Project, possible impacts	Puget Sound Area Study Team
$9.1 M	Service to Puget Sound Load area and System Reliability	Schedule delayed from 2013		Single System Project, possible impacts	
$65-$80 M	Load service, Capacity Increase, Reliability			Single System Project	Puget Sound Area Study Team
$3 M					Puget Sound Area Study Team
$2 M					Puget Sound Area Study Team
$13 M					Puget Sound Area Study Team
$3 M					Puget Sound Area Study Team
$18 M	Capacity increase	New Project			Puget Sound Area Study Team
$14 M	Load service, Reliability			Single System Project	
$13 M	Replace aging infrastructure (existing Bellingham Sub) and increase system reliability	New Project		Single System Project	

Puget Sound Projects continued

Project Name	Description	Sponsor	Parties Impacted by Project	Link to More Detail	Project Stage	Project Commitment Level	Scheduled Completion
Sammamish Reliability Improvements	Add 230 kV bus section breaker	PSE			Design and Construction	Funding approved by sponsor	2012
Woodland-St. Clair	Add new Woodland-St. Clair 115 kV line	PSE			Design and Construction	Committed Project	2015

Cost Estimate	Project Need/Driver & Other Notes	Changes from Previous Plan	Plan cross tribal lands	Type of Project	Study Team(s)
$1 M	Load service, Capacity increase, Reliability			Single System Project	
$13 M	Reliability			Single System Project	

Central Washington Projects

Project Name	Description	Sponsor	Parties Impacted by Project	Link to More Detail	Project Stage	Project Commitment Level
Mid-Columbia Area Reinforcement	Rebuild 9 miles of the Vantage-Midway 230 kV line (about 10 miles is already rebuilt) in Central WA. Add sectionalizing breakers at Vantage and Midway substations.	BPA	PAC & Grant		Completed	
Mid-Columbia Area Reinforcement	Wanapum-Pomona Heights 230 kV #2 Line in the Yakima area.	PAC	BPA, Grant			
Northern Mid-Columbia Area Support	Douglas-Rapids 230 kV line, Douglas 230/115 kV transformer, Rapids 115 kV Substation with terminations for Pangborn, South Nile and Hanna 115 kV lines	Douglas	Douglas, Chelan, BPA, Grant, PSE		Plan of Service Determined	sponsor committed
Northern Mid-Columbia Area Support	Rebuild McKenzie to Wenatchee Tap 115 kV line	Chelan County PUD			Completed	
Northern Mid-Columbia Area Support	Build new Rapids-Columbia 230 kV line	unknown	Douglas, Chelan, BPA, Grant, PSE		Plan of Service Determined	Project identified as need
Mid-Columbia Area Reinforcement, Phase 2	Upgrade Wanapum-Midway 230 kV line in central WA.	Grant County PUD				Project identified as future need
Columbia - Larson 230 kV Line	Construct a new 230 kV line from Rocky Ford to Columbia, connect to existing Rocky Ford-Larson 230 kV line to form Columbia-Rocky Ford line.	Grant County PUD	Interconnect w/BPA at Columbia Sub			
Ashe 500/115 kV transformer	Add a 500/115 kV transformer at Ashe with a line tapping the proposed Ashe-Benton 115 kV line	BPA			Conceptual Project for Future Need	Project identified as future need
Union Gap Transformation	Add third 230/115 kV transformer at Union Gap	PacifiCorp				
Okanogan Area	Add 26 MVAR capacitor at East Omak Substation	BPA				
Sacajawea 115 kV Tie Line	Construct a 115 kV line (0.5 mile) from Sacajawea Substation to tap the Ice Harbor-Franklin 115 kV #3 line	BPA				Committed
McKenzie - Andrew York #1 Re-rate	Re-rate the existing McKenzie - Andrew York #1 115 kV line from 50 C MOT to 75 C MOT	Chelan County PUD			Plan of Service Determined	
McKenzie - Andrew York #2 Re-rate	Re-rate the existing McKenzie - Andrew York #2 115 kV line from 50 C MOT to 75 C MOT	Chelan County PUD			Plan of Service Determined	
Rocky Ford - Dover 115 kV line	Construct 115 kV Rocky Ford-Dover 115 kV line	Grant County PUD				
Tri-Cities Reinforcements	Franklin 115 kV 104 MVAR capacitor addition	BPA				Committed
White Bluffs Capacitors	Add 39 MVAR shunt capacitor at White Bluffs Substation	BPA				Committed

Cost Estimate	Project Need/Driver & Other Notes	Changes from Previous Plan	Plan cross tribal lands	Type of Project	Study Team(s)
$16.9 M	Load growth in Mid Columbia area and transfers of generation out of the area	Completed		Existing Obligation Project	NTAC
	Load growth in Yakima area			External Project	NTAC
$16.9 M	Load growth		No	Existing Obligation Project	Northern Mid-Columbia Study Group
$6M	Mitigate reliability criteria violations.	Completed		Single System Project	Northern Mid-Columbia Study Group
$10.9 M	Load growth and transfers		No	Existing Obligation Project	Northern Mid-Columbia Study Group
	Load growth, new wind generation plants and transfers of generation out of the area			Existing Obligation Project	
$42 M	Load growth, increase transmission system reliability and improve voltage stability performance.			Single System Project with possible parallel impacts	Northern Mid-Columbia Study Group
				Single System	
	Load growth		No	Single System Project	
$930,000	Load growth and system reliability	Delayed from 2012		Single System Project	
$3 M	Load growth	Delayed from 2013		Single System Project	
$200,000	Increase transmission system reliability		No	Single System Project	
$300,000	Increase transmission system reliability		No	Single System Project	
$5 M	Increase transmission system reliability			Single System Project	
$3.1 M	Voltage Support and load growth	Delayed from 2014		Single System Project	
$1.93 M	Reliability for Columbia Generating Station			Single System	

Northeastern Projects

Project Name	Description	Sponsor	Parties Impacted by Project	Link to More Detail	Project Stage	Project Commitment Level	Scheduled Completion
Spokane Area 230 kV Reinforcement	Add a 230/115 kV transformer in Garden Springs Substation with 230 kV lines to Westside and either Beacon/Boulder 230 kV switching stations	Avista			Project identified as future need		2015
Benton-Othello 115 kV Rebuild	Rebuild Benton-Othello 115 kV line	Avista			Committed project		2013
Westside Project	Westside 230 kV Substation rebuild and transformer upgrades	Avista			Committed project		2014
Moscow 230/115 kV Upgrade	Increase Moscow transformer capacity to 250 MVA and rebuild 230 kV substation	Avista			Committed project		2012
Spokane Valley Transmission Reinforcements	New Irwin-IEP 115 kV transmission line and reconductor Beacon-Boulder and Opportunity Tap 115 kV lines	Avista			Committed project		2013
Lancaster CT Integration	Loop Boulder-Rathdrum 230 kV line into Lancaster	Avista			Committed project		2013
Bronx-Cabinet 115 kV Rebuild	Rebuild/reconductor Bronx-Cabinet 115 kV line	Avista			Committed project		2015
Lewiston 10 Year Plan	Second Hatwai-Lolo 230 kV line is one solution, long range study needed	Avista	BPA, IPCO, PAC		Project identified as long term need		10 years
Tucannon-Walla Walla Line Upgrade	Rebuild the Tucannon-Walla Walla 115 kV line section with new structures and higher capacity conductor.	BPA				Energized	
Little Goose Area Reinforcement	Add 40 mile 500 kV line from new wind collection station called Central Ferry to Lower Monumental Substation	BPA			Funding for NEPA and preliminary engineering is Committed under NOS	Commitment depends upon NEPA	2013
Wallula-McNary 230 kV line	A new 230 kV line from Wallula to the McNary/Boardman/NEO area	PAC	BPA		In WECC Rating Process		2012
Hatwai 230 kV Bus Section Breaker	Add 230 kV bus section breaker at Hatwai Substation	BPA					2015
Tucannon Shunt Capacitors	Add two groups of 6.6 MVAR, 115 kV capacitors at Tucannon Substation	BPA				Committed	2013
Columbia Falls Bus Section Breakers	Add 230 kV and 115 kV bus section breakers at Columbia Falls	BPA				Committed	2013-15
MATL Project	The Montana Alberta Tie Ltd Project is a 200 mile, 300 MW, 230 kV line connecting Lethbridge, Alberta and Great Falls, Montana going through Cutbank, Montana which has significant wind generation potential.	Enbridge			Under Construction	Permitted	2012-13
Green Line Project	This project is a 100 mile extension of the MATL project to connect to the Colstrip Transmission. This project will provide access to the Mid-Columbia Hub (up to 1000 MW Capacity).	Enbridge	Colstrip Transmission Owners		Feasibility State		
Colstrip Upgrade Project	This project is proposed to meet a portion of the 2010 BPA NOS requests. Upgrades to the Montana to Northwest and West of Hatwai paths is proposed without any new line construction by upgrading existing and adding new series compensation in the lines. With the new project, the capability of the system will be increased between 550 and 700 MW.	BPA	AVA and other Colstrip Owners			Committed under BPA NOS	2015
Garrison-Ashe Project	This project is proposed to meet the full capacity of the 2010 BPA NOS requests. A 430 mile series compensated Garrison-Ashe 500 kV line is proposed with an intermediate station between Taft and Hot Springs.	BPA	AVA		Conceptual Project	None	

Cost Estimate	Project Need/Driver & Other Notes	Changes from Previous Plan	Plan cross tribal lands	Type of Project	Study Team(s)
	Load Growth in the south Spokane area			Single System Project with possible impacts	
				Single System Project with possible	
				Single System Project	
		Moved up from 2013		Single System Project	
				Single System Project	
				Single System Project with possible impacts	
				Single System Project with possible impacts	
	Loss of Hatwai-Lolo and Hatwai-North Lewiston 230 kV lines for heavy flows to Walla Walla and Idaho				Needed
	Repair aging line	Energized		Single System Project	
$99 M	To serve requests made under 2008 Network Open Season	Need being reviewed?		Requested Service Project	
	Transmission Service Requests			Requested Service Project	
$4.2 M	Load growth and system reliability	Delayed from 2014		Single System	
$1.9 M	Voltage support and generation integration			Single System	
$4 M	Load growth and system reliability	Delayed from 2012-14		Single System	
$209 M	Transmission Service Requests	Project delayed to 2012-13			
	Transmission Service Requests				
	Committed under BPA NOS	New Project		Requested Service Project	
	Meet 2010 NOS Requests			Requested Service Project	

Western Projects

Project Name	Description	Sponsor	Parties Impacted by Project	Link to More Detail	Project Stage	Project Commitment Level	Scheduled Completion
Lebanon Area Reinforcement	Add a 19.6 MVAR, 115 kV shunt capacitor bank at Lebanon Substation	BPA			Plan of service determined	Funding approved by sponsor	2012
I-5 Corridor (SW Washington - NW Oregon Reinforcement)	Construct a new 500 kV line (approx. 70 miles) from Troutdale Substation to the new Castle Rock Substation located approximately 12 miles north of Allston Substation on the Paul-Allston No.1 500 kV line.	BPA	PAC		Funding for NEPA and preliminary engineering is committed under NOS	Depends upon NEPA	2016
Pearl – Sherwood 230 kV Line Reconfiguration	PGE and BPA plan to re-terminate the existing double circuit operating in parallel between BPA's Pearl Substation and PGE's Sherwood Substation. In addition, PGE will re-terminate at Sherwood the existing double circuit operating in parallel as the McLoughlin-Pearl-Sherwood 230kV circuit. This will require two new circuit breakers at Sherwood and two new circuit breakers at Pearl. When the project is completed, there will be a Pearl-Sherwood #1 230 kV circuit, a Pearl-Sherwood #2 230 kV circuit, a Pearl-Sherwood #3 230kV circuit, and a McLoughlin-Pearl-Sherwood 230kV circuit.	PGE and BPA	PGE and BPA		Project under study	Project identified as future need	2017
Cross-Cascades South	Station K development connecting Ashe-Marion, Buckley-Marion and both John Day-Grizzly lines together at a new station where the lines cross.	BPA	PGE, PAC			Conceptual project for future need	2020
Cascade Crossing Project	The Cascade Crossing Project is a 200 mile 500 kV line from PGE's Coyote Springs generation plant in the town of Boardman, Oregon west to PGE's Bethel Substation in Salem, Oregon where the line will be terminated into a new 500/230 kV transformer bank. The new line will interconnect at a new Grassland substation adjacent to the existing Boardman power plant and a new Cedar Spring substation approximately 36 miles southwest of the Boardman power plant.	PGE, PAC, BPA		http://cascadecrossingproject.com/	In WECC Rating Process	Committed	2016-2017
Horizon Phase II	This project consists of a new Trojan-Horizon 230 kV line and Horizon 230/115 kV transformer. This project is the result of a merchant request and will provide the capacity needed to integrate proposed generation near Port Westward.	PGE	Impacts to South of Allston		Project under study	Project identified as future need	2017
Sunset-Horizon 230 kV line with 230/115 kV transformer at Horizon	Construction of a new line between Sunset and Horizon Substations (1 mile) and the addition of a 230/115 kV 320 MVA transformer at Horizon Substation.	PGE	Connection to BPA via Keeler		Plan of service determined	Under construction	2012
Blue Lake-Gresham 230 kV Line	Construct a transmission line from Blue Lake Substation (Troutdale, Oregon) to Gresham Substation (Gresham, Oregon). This project requires 4.2 miles of new 230 kV transmission line.	PGE	BPA		Plan of service determined	Included in sponsors budget	2017
Longview-Cowlitz 115 kV #2	Create second 115 kV connection between BPA Longview and BPA Cowlitz. This will be done by using existing Cowlitz 69 kV circuit and converting to 115 kV from BPA Longview through Washington Way and 7th Ave Substations and adding tap from 7th Ave to BPA Cowlitz Substation.	Cowlitz/BPA				Under Construction	2012
Longview-Lexington 115 kV line #2	Create a connection between BPA Longview and Lexington Substations through Cowlitz Substations (Mint Farm, Olive Way, 20th and Ocean Beach and West Kelso).	Cowlitz	BPA will replace 115 kV Breaker			Funding approved by sponsor	2013-14
Longview-Lexington-Cardwell 115 kV line	Create a connection between BPA Longview, Lexington, East Kelso and Cardwell substations through Cowlitz substations with a 115 kV connection between East and West Kelso.	Cowlitz	BPA will replace 115 kV Breaker			Funding approved by sponsor	2015-17

Cost Estimate	Project Need/Driver & Other Notes	Changes from Previous Plan	Plan cross tribal lands	Type of Project	Study Team(s)
$3 M	Load growth	Delayed from 2011		Single System	
$342 M	Transmission Service Requests	Delayed to 2016		Requested Service Project	I-5 Corridor Regional Planning Study Team
	Reliability	moved date from 2016 to 2017		Multi-system EOP with only one ColGrid participant	
	Load growth			Multi-system EOP with only one ColGrid participant	West of Cascades Study Team
$610-825 M	Transmission service request	Delayed from 2015		Multi-system EOP with only one ColGrid participant	TCWG
	Transmission Service Requests	No commitment from requestor		Single System Project	
	Load service			External Project	
	Reliability			External Project	
$5 M	Reliability and load growth			Single System Project	
	Reliability and load growth			Single System Project	
	Reliability and load growth			Single System Project	

Western Projects continued

Project Name	Description	Sponsor	Parties Impacted by Project	Link to More Detail	Project Stage	Project Commitment Level	Scheduled Completion
Kalama Energy	Construct new 230 kV line from BPA Longview to Kalama.	Cowlitz	BPA		Project under study	Conceptual project for future need	2012-2018 Current estimate 2013
Rogue SVC (South Oregon Coast)	Add a -45 to +50 MVAR, Static VAR Compensator (SVC) at Rogue Substation connected to the 115 kV bus	BPA			Construction		2012
South Oregon Coast Transmission Reinforcement	Rebuild Bandon-Rogue 115 kV line or construct a new 115 kV transmission line to provide a new source to the South Oregon Coast load area	BPA				Project under study	
Eugene-Albany Rebuild	Rebuild a section of the Albany-Eugene 115 kV line with new structures and higher capacity conductor	BPA			Completed	Plan of service determined	Completed
Whetstone 230/115 kV Transformer addition	Add a 230/115 kV substation in the Medford area fed from the Grants Pass-Meridian 230 kV line	PAC					2013
Lookingglass Substation	New Lookingglass Substation on Dixonville-Reston 230 kV line	PAC					2013
North Bonneville-Ross and North Bonneville-Troutdale Line Swap	This line swap places the North Bonneville-Troutdale #2 230 kV line on the double circuit towers with the North Bonneville-Ross #2 line to prevent thermal overloads which could result from the existing double circuit line outage.	BPA				Committed	2012
Forest Grove Loop-in of the Tillamook-Keeler 115 kV line	Loop the Keeler-Tillamook 115 kV line into Forest Grove Substation and upgrade the Keeler-Forest Grove section of the Keeler-Tillamook 115 kV line.	BPA				Committed	2012
Pearl 500 kV Bay Addition	Construct a new Pearl 500 kV bay #6 and reterminate the Ostrander-Pearl 500 kV line into the new bay	BPA				Committed	2012
Keeler 230 kV Bus Section Breaker	Install a 230 kV bus sectionalizing break at Keeler between bays #4 and #5 to balance the sources and loads at Keeler.	BPA				Committed	2014
Ostrander Additions	Add a new 500 kV breaker in bay 5 at Ostrander for the Troutdale #1 line	BPA	PGE			Committed	2014
Ostrander 500/230 kV Transformer	Add new 500/230 kV transformer at Ostrander to replace McLoughlin transformer	BPA				Committed	2012
Longview-Lexington 230 kV Re-termination	This project involves re-terminating the Longview-Lexington 230 kV line to the Longview Annex	BPA				Committed	2015
Woodland Bulk Power Support	Develop a new station with 230 kV breakers, a 230/115 kV Autotransformer and 115 kV bus and breakers where the Speelyai 230 kV line joins the Ross-Lexington 230 kV line.	Cowlitz	Clark PUD , BPA, PacifiCorp.				2017-2019

Cost Estimate	Project Need/Driver & Other Notes	Changes from Previous Plan	Plan cross tribal lands	Type of Project	Study Team(s)
$20 M	To connect the new Kalama Energy 680 MW gas turbine project and/or to provide for load growth in area			Single System Project	
$9 M	Southern Oregon load growth - needs dynamic SVC control v. static caps.	Delayed from 2011		Single System Project	
	Load growth along southern Oregon coast			Single System Project	
	To meet load growth projections and repair aging line	Completed		Single System Project	
	Reliability and load growth			Single System Project	
	Reliability and load growth			Single System Project	
435000	Load growth and system reliability			Single System Project	
$2.135 M	Local load growth			Single System Project	
$4.16 M	Local load growth			Single System Project, possible impacts	
$2.33 M	Local load growth	Delayed from 2012		Single System Project	
$31 M	System reliability			Single System Project, possible impacts	
$3.5 M	Local load growth			Single System Project	
$1.1 M	Local load growth	Delayed from 2014		Single System Project	
	Local load growth and needed voltage/ reliability support	BPA and ColumbiaGrid are studying project		Single System Project, possible impacts	

Eastern Projects

Project Name	Description	Sponsor	Parties Impacted by Project	Link to More Detail	Project Stage	Project Commitment Level	Scheduled Completion
Lower Valley Reinforcement (Hooper Springs)	This is a joint project with BPA, PacifiCorp, and Lower Valley Energy. PacifiCorp will construct Three Mile Knoll - a new 345/138 kV substation. The Goshen-Bridger 345 kV line will be looped into the new substation. BPA will construct Hooper Springs - a new 138/115 kV substation. Lower Valley Energy will construct a new double circuit 115 kV line (approximately 20 miles) from Hooper Springs to Lanes Creek/Valley Substations.	BPA/ PAC/ Lower Valley Electric				construction on hold pending agreement	2013-14
COI Reinforcement (4800 MW)	This project includes 2-500 kV series capacitor groups added at Bakeoven; 2-500 kV shunt capacitor groups added at Captain Jack; and a 500 kV shunt capacitor group added at Slatt Substation. This project also includes upgrading the John Day-Grizzly 500 kV lines No.1 & 2, and control and communications.	BPA	PacifiCorp, PGE		Completed	Funding approved by sponsor	Completed
Redmond 230/115 kV Transformer Bank No.2	Add a second 230/115 kV transformer bank at Redmond Substation with 115 kV and 230 kV bus section breakers.	BPA			Completed		Completed
McNary - John Day 500 kV line	Construct a new 500 kV line (approximately 79 miles) from McNary to John Day Substation	BPA			Completed		Completed
Big Eddy - Knight 500 kV line	Construct a new 500 kV line (approximately 29 miles) from Big Eddy to a new Knight Station, which connects to the Wautoma-Ostrander 500 kV line. (3 breaker ring bus)	BPA			Project Committed under Network Open Season	Under Construction	2013
Central Oregon 500/230 kV Transformer Bank Addition	Add second 500/230 kV 700 MVAR transformer at Ponderosa.	BPA	PAC		Preliminary engineering and NEPA	Under Construction	2013
La Pine capacitors	Add a 19 MVAR shunt capacitor at La Pine Substation	BPA			Committed	Committed	2012
McNary Shunt Capacitors	Add 2 groups of 230 kV 180 MVAR shunt capacitors at McNary	BPA				Committed	2014
Jones Canyon Shunt Capacitors	Add 2 groups of 230 kV 29 MVAR shunt capacitors at Jones Canyon	BPA			Completed	Committed	Completed
De Moss-Fossil 115 kV Line Upgrade	Upgrade De Moss-Fossil 69 kV Line to 115 kV	BPA				Committed	2012
Hilltop Shunt Reactor	Add a 40 MVAR 230 kV shunt reactor at Hilltop Substation	BPA				Committed	2013

Cost Estimate	Project Need/Driver & Other Notes	Changes from Previous Plan	Plan cross tribal lands	Type of Project	Study Team(s)
$48 M	Load growth in eastern Idaho	Schedule moved from 2012		Multi-system EOP with only one ColGrid participant	
$63 M	Remove nomogram limitations on COI	Completed		Capacity Increase Project	
$12 M	Load growth and system reliability	Completed		Single System	Joint studies w/PAC, BPA and Central Electric Coop
$183 M	Transmission Service Requests	Completed		Requested Service Project	West of McNary Regional Planning Study Team
$124 M	Transmission Service Requests			Requested Service Project	West of McNary Regional Planning Study Team
$31 M	Load growth and loss of the existing transformer	Project committed with transformer at Ponderosa		Multi-system EOP with only one ColGrid participant	
$1.3 M	Load growth and system reliability			Single System Project	
$5.6 M	Voltage support and generation integration			Single System	
$3.3 M	Voltage support and generation integration	Completed		Single System	
$7.5 M	Voltage support and generation integration	Delayed		Single System	
2.5 M	Voltage support			Single System	

Regional Projects

Project Name	Description	Sponsor	Parties Impacted by Project	Link to More Detail	Project Stage	Project Commitment Level
West of McNary Area Reinforcement Project	This project consists of a new 500 kV line from McNary Substation to John Day Substation which has been completed and a new 500 kV line (approximately 29 miles) from Big Eddy Substation to a tap point (3 breaker Ring at a new station called Knight) along the Wautoma-Ostrander 500 kV line.	BPA			Completed WECC Regional Planning, now in Technical Coordination Work Group (TCWG)	Project Committed under Network Open Season. In permitting process.
I-5 Corridor Project (SW Washington - NW Oregon Reinforcement)	This project consists of a new 500 kV line (70-90 miles) from Troutdale Substation to a Castle Rock Substation located approximately 12 miles north of Allston Substation on the Paul-Allston No.1 500 kV line.	BPA	PGE		Completed WECC Regional Planning, now in WECC rating Process in the TCWG	Funding for NEPA and preliminary Engineering is Committed under Network Open Season
Cascade Crossing Project	The Cascade Crossing Project is a 200 mile 500 kV line from PGE's Coyote Springs generation plant in the town of Boardman, Oregon west to PGE's Bethel Substation in Salem, Oregon where the line will be terminated into a new 500/230 kV transformer bank. The new line will interconnect at a new Grassland substation adjacent to the existing Boardman power plant and a new Cedar Spring substation approximately 36 miles southwest of the Boardman power plant.	PGE, PAC, BPA		http://cascadecrossingproject.com/	In WECC Rating Process	
Gateway West Project	Idaho Power and PacifiCorp are proposing a joint project with a 500 kV line from Winstar Substation (near Glenrock Wyoming) to Hemingway Substation in the Boise area.	Idaho and PAC			In WECC Rating Process	
Hemingway - Boardman Project	In conjunction with the Gateway West project, Idaho Power is looking to extend this project from Hemingway Substation further to the north and west to the Boardman Substation.	Idaho/PAC/ BPA	BPA, Avista, PAC		In WECC Rating Process	
PG&E Canada - Pacific Northwest – Northern California Transmission Line Project	PG&E is proposing a 500 kV AC line from Selkirk Substation in SE British Columbia to NEO, along with an High Voltage DC line from NEO to the Tesla/Tracy area in the San Francisco Bay area. The bi-directional capacity of this line is planned to be 3,000 MW. Interconnections are also being considered at Devils Gap in the Spokane area and Round Mountain Substation in Northern California.	PG&E/AVA/ BCH	BPA, PSE, PGE, PAC		In WECC Rating Process	
Devil's Gap Interconnection to Canada - PNW – Northern California Transmission Line Project	In conjunction with the PG&E Canada-NW-Northern California Project, Avista is proposing an interconnection at Devil's Gap west of Spokane.	Avista	BPA		In WECC Rating Process	
Northern Lights Project	High Voltage Direct Current line beginning at Edmonton, Alberta and ending near Maupin, Oregon. At least one intermediate terminal is planned in a location south of Calgary, near Alberta's largest wind development region. The project is planned to be a bi-directional line with an expected capacity of up to 3,000 MW.	Northern Lights	BPA		In WECC Rating Process	
Juan de Fuca Cable Project #1	SeaBreeze Pacific is proposing an underwater 550 MW HVDC Light cable from Vancouver Island in BC to the Port Angeles, WA area across the Strait of Juan de Fuca. This project rating is planned to be bi-directional.	SeaBreeze	BPA, PSE		In WECC Rating Process	
Juan de Fuca Cable Project #2	Sea Breeze Pacific is proposing a Multi-terminal underwater 1,100 MW high-voltage DC cable (+/- 300 kV) across the Strait of Juan de Fuca from Ingledow Substation near Vancouver, British Columbia, Canada to Pike Substation near Victoria on Vancouver Island Canada, to either the Shelton or Olympia Substations on the Olympic Peninsula, Washington. The 1100 MW project rating is planned to be fully controllable and bi-directional.	SeaBreeze	BPA		In WECC Rating Process	
West Coast Cable	SeaBreeze Pacific is proposing an underwater HVDC cable from Allston Substation in NW Oregon near Rainier to San Francisco Bay area. This project has a planned capacity of 1600 MW.	SeaBreeze	BPA		In WECC Rating Process	
Colstrip Upgrade Project	This project is proposed to meet a portion of the 2010 BPA NOS requests. Upgrades to the Montana to Northwest and West of Hatwai paths is proposed without any new line construction by upgrading existing and adding new series compensation in the lines. With the new project, the capability of the system will be increased between 550 and 700 MW.	BPA	AVA and other Colstrip Owners		Project under study	Committed
Garrison-Ashe Project	This project is proposed to meet the full capacity of the 2010 BPA NOS requests. A 430 mile series compensated Garrison-Ashe 500 kV line is proposed with an intermediate station between Taft and Hot Springs.	BPA	AVA		Conceptual Project	None
MATL Project	The Montana Alberta Tie Ltd Project is a 200 mile, 300 MW, 230 kV line connecting Lethbridge, Alberta and Great Falls, Montana going through Cutbank, Montana which has significant wind generation potential.	Enbridge			Under Construction	Permitted
Green Line Project	This project is a 100 mile extension of the MATL project to connect to the Colstrip Transmission. This project will provide access to the Mid-Columbia Hub (up to 1000 MW Capacity).	Enbridge	Colstrip Transmission Owners		Feasibility State	

Scheduled Completion	Cost Estimate	Project Need/Driver & Other Notes	Changes from Previous Plan	Plan cross tribal lands	Type of Project	Study Team(s)
2013		Transmission Service Requests	John Day-McNary line energized			ColGrid West of McNary Regional Planning Study Team and TCWG
2016	$342 M	Transmission Service Requests				ColGrid I-5 Corridor Regional Planning Study Team and TCWG
2016-2017	$610-825 M	Transmission service request	Delayed from 2015		Multi-system EOP with only one ColGrid participant	TCWG
2014-18		Transmission Service Requests				TCWG
2016	$630-820 M	Transmission Service Requests				TCWG
possible delay			Lower capacity alternatives being considered			TCWG
possible delay						TCWG
on hold						TCWG
2012						TCWG
						TCWG
						TCWG
2015		Meet 2010 NOS Requests			Requested Service Project	
2018		Meet 2010 NOS Requests			Requested Service Project	
2012-13	$209 M	Transmission Service Requests	Delayed until 2012-13			
		Transmission Service Requests				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