

NTTG 2019 Annual Interregional Information

Annual Interregional Coordination Meeting
Salt Lake City
February 19, 2019



Topics

- NTTG's Planning Process Overview
- NTTG's 2018-2019 Draft Regional Transmission Plan
 - Methodology and System Representation, including Interregional Transmission Projects
 - Base Case Development and Change Case Selection Process
 - Metrics Evaluation and Draft Plan Results
- Next Steps and How to Participate



NTTG Planning Process Overview

Presented by Sharon Helms, NTTG Program Manager



NTTG Planning Region

Participating Utilities

Deseret Power Electric Cooperative
Idaho Power
MATL LLP
NorthWestern Energy
PacifiCorp
Portland General Electric
Utah Associated Municipal Power Systems

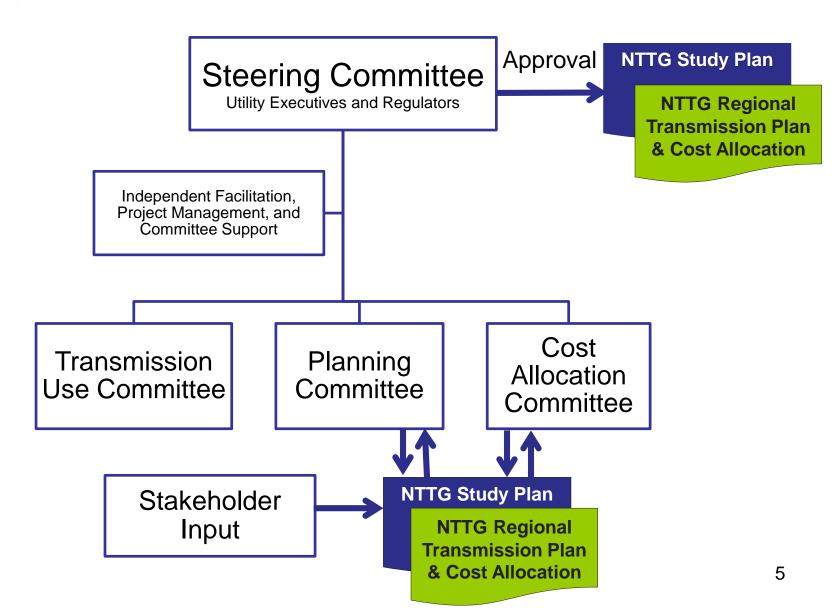
Participating State Representatives

Idaho Public Utilities Commission
Montana Consumer Counsel
Montana Public Service Commission
Oregon Public Utility Commission
Utah Office of Consumer Services
Utah Public Service Commission
Wyoming Office of Consumer Advocates
Wyoming Public Service Commission





NTTG Structure





2018-2019 Planning Cycle





2018-2019 Draft Regional Transmission Plan Methodology and System Representation

Presented by Chelsea Loomis, NTTG Planning Committee Chair

NTTG 2018-2019 Draft Regional Transmission Plan

- The plan proposes a strategy to meet the transmission needs of the NTTG region in year 2028.
- The plan aims to reliably meet the region's future transmission needs in a manner that is more efficient or cost-effective than an Initial Regional Plan, and
- Is comprised of a combination of the funding Transmission Providers' local transmission plans.

Transmission Plan Analysis

- Developed the Regional Transmission Plan through analysis
 - reliability (power flow)
 - Transmission Capacity and
 - benefit (changes in capital costs, losses, and reserves)

of

- Initial Regional Plan (IRTP)
- IRTP without uncommitted projects
- Alternative projects

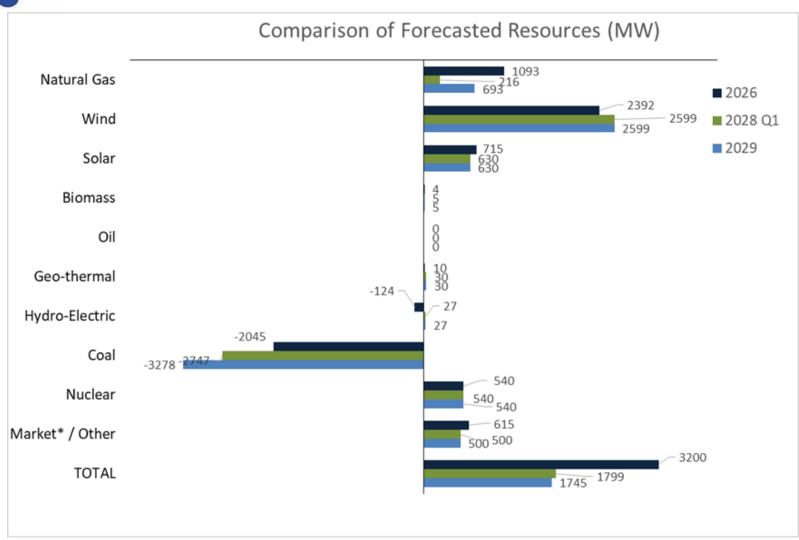


Quarter 1 Load Submittal

SUBMITTED BY:	2017 Actual Peak Demand (MW)	2026 Summer Load Data Submitted in 2016-17 (MW)	2028 Summer Load Data Submitted in Q1 2018 (MW)	Difference (MW) 2026- 2028
Idaho Power	3,806	4,346	4,412	66
NorthWestern	1,803	1,992	2,027	35
PacifiCorp	12,664	13,044	13,386	342
Portland General	4,023	3,885	3,928	43
TOTAL*	22,266	23,267	23,753	486
* Loads for Deseret	G&T and UAMPS	are included in F	PacifiCorp East	



Quarter 1 Resource Submittal



Quarter 1 Resource Submittal

State	Net Resource Change (MW)
Arizona	-414
California	0
Colorado ⁸	-82
Idaho	588
Montana	573
Oregon	-391
Utah	452
Washington	108
Wyoming	727



Quarter 1 Coal Retirements

Coal Unit	Retirement Date	Study Treatment		
Naughton 3	12/2018	Retired		
Valmy 1	12/2019	Retired		
Boardman	12/2020	Retired		
Cholla 4 ⁴	12/2020	Retired		
Colstrip 1 & 2	7/2022	Retired		
Valmy 2	12/2025	Retired		
Craig 1 ⁴	12/2025	Retired		
Dave Johnson 1, 2, 3, 4	12/2027	Retired		
Bridger 1	12/2028	On-line,		
		Retired in Sensitivity case		

¹¹ Units are assumed to retire at the end of the stated month.



Q1 Transmission Additions

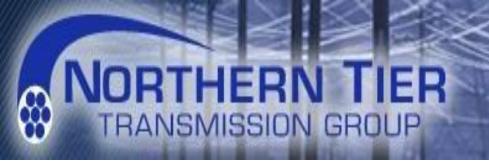
Submitter	From	То	Voltage	Circuit	Туре	Regionally Significant ¹	Committed	Projects (In-service Year)
	Hemingway	Longhorn	500 kV	1	LTP & pRTP	Yes	No	B2H Project (2026)
	Hemingway	Bowmont	230 kV	2	LTP	Yes	No	New Line - associated with Boardman to Hemingway (2026)
	Bowmont	Hubbard	230 kV	1	LTP	Yes	No	New Line - associated with Boardman to Hemingway (2026)
	Hubbard	Cloverdale	230 kV	1	LTP	No	No	New Line (2021)
Idaho Power	Midpoint	Hemingway	500 kV	2	LTP	Yes	No	Gateway West Segment #8 (joint with PacifiCorp East) (2024)
	Cedar Hill	Hemingway	500 kV	1	LTP & pRTP	Yes	No	Gateway West Segment #9 (joint with PacifiCorp East) (2024)
	Cedar Hill	Midpoint	500 kV	1	LTP	Yes	No	Gateway West Segment #10 (2024)
	Midpoint	Borah	500 kV	1	LTP	Yes	No	(convert existing from 345 kV operation) (2024)
	Ketchum	Wood River	138 kV	2	LTP	No	No	New Line (2020)
	Willis	Star	138 kV	1	LTP	No	No	New Line (2019)
Enbridge	SE Alberta		DC	1	LTP	Yes	No	MATL 600 MW Back to Back DC Converter (2024)
	Aeolus	Clover	500 kV	1	LTP & pRTP	Yes	No	Gateway South Project – Segment #2 (2024)
	Aeolus	Anticline	500 kV	1	LTP & pRTP	Yes	No	Gateway West Segments 2&3 (2020)
	Anticline	Jim Bridger	500 kV	1	LTP & pRTP	Yes	No	345/500 kV Tie (2020)
	Anticline	Populus	500 kV	1	LTP & pRTP	Yes	No	Gateway West Segment #4 (2024)
	Populus	Borah	500 kV	1	LTP	Yes	No	Gateway West Segment #5 (2024)
	Populus	Cedar Hill	500 kV	1	LTP & pRTP	Yes	No	Gateway West Segment #7 (2024)
PacifiCorp	Antelope	Goshen	345 kV	1	LTP	Yes	No	Nuclear Resource Integration (2026)
East	Antelope	Borah	345 kV	1	LTP	Yes	No	Nuclear Resource Integration (2026)
	Windstar	Aeolus	230 kV	1	LTP & pRTP	Yes	No	Gateway West Segment #1W (2024)
	Oquirrh	Terminal	345 kV	2	LTP	Yes	Yes	Gateway Central
	Cedar Hill	Hemingway	500 kV	1	LTP	Yes	No	Gateway West Segment #9 (joint with Idaho Power) (2024)
	Shirley Basin	Standpipe	230 kV	1	LTP	Yes	No	Local Wind Integration (2020)
PacifiCorp West	Wallula	McNary	230 kV	2	LTP	Yes	Yes	Gateway West Segment A (2020)
	Blue Lake	Gresham	230 kV	1	LTP	No	Yes	New Line (2018)
	Blue Lake	Troutdale	230 kV	1	LTP	No	Yes	Rebuild (2018)
	Blue Lake	Troutdale	230 kV	2	LTP	No	Yes	New Line (2018)
	Horizon	Springville Jct	230 kV	1	LTP	No	Yes	New Line (Trojan-St Marys-Horizon) (2020)
Portland	Horizon	Harborton	230 kV	1	LTP	No	Yes	New Line (re-terminates Horizon Line) (2020)
General	Trojan	Harborton	230 kV	1	LTP	No	Yes	Re-termination to Harborton (2020)
	St Marys	Harborton	230 kV	1	LTP	No	Yes	Re-termination to Harborton (2020)
	Rivergate	Harborton	230 kV	1	LTP	No	Yes	Re-termination to Harborton (2020)
	Trojan	Harborton	230 kV	2	LTP	No	Yes	Re-termination to Harborton (2020)
			115 kV	1	LTP	No	Yes	Various Load Service Additions (2019-2024)

Q1 Interregional Transmission Projects

SUMMARY OF Q1-2018 INTERREGIONAL PROJECTS SUBMITTED TO NTTG

Project Name	Company	Relevant Planning Region(s)	Termination From	Termination to	Status	In Service Date
Cross-Tie Transmission Project	TransCanyon, LLC	NTTG, WestConnect	Clover, UT	Robinson Summit, NV	Conceptual	2024
SWIP-North	Great Basin Transmission LLC	CAISO ¹ , NTTG, WestConnect	Midpoint, ID	Robinson Summit, NV	Permitted	2021
TransWest Express Transmission DC/AC Project	TransWest Express, LLC	CAISO, NTTG, WestConnect	Rawlins, WY	Boulder City, NV	Conceptual	2022
TransWest Express Transmission DC Project	TransWest Express, LLC	CAISO, NTTG, WestConnect	Rawlins, WY	Boulder City, NV	Conceptual	2022

¹The California ISO has voluntarily agreed to study the SWIP-N line and accept cost allocation if the project is found to be needed by the California ISO and is ultimately constructed.



Base Case Development and Change Case Selection

Presented by Chelsea Loomis, NTTG Planning Committee Chair



Nine Stressed Conditions Identified for Analysis

Base Conditions

- A. Peak coincident Summer Load condition
- B. Peak coincident Winter Load condition
- C. High eastbound flows on Idaho-Northwest
- D. High westbound flows on Idaho-Northwest (after reviewing condition further analysis has been dropped)
- E. High southbound flows on Tot2/PACI/PDCI
- F. High Wyoming wind
- G. High Borah West flows
- H. High NTTG import
- High flows west and south out of Wyoming

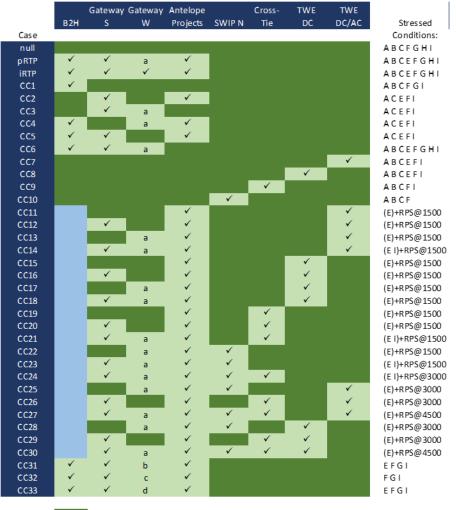


TWG Case Terminology

- Null all iRTP facilities excluded
- pRTP Prior Regional Transmission Plan, includes:
 - B2H, McNary-Wallula, Gateway West (less Populus-Borah, Cedar Hill-Midpoint and Midpoint-Hemingway), Gateway South and Antelope Projects
 - Un-committed Bulk Electric System facilities outside the NTTG footprint
- iRTP Initial Regional Transmission Plan, includes:
 - B2H, McNary-Wallula, Gateway West, Gateway South, Antelope Projects, local load serving projects
 - Un-committed BES facilities outside the NTTG footprint



Change Case Matrix



- The change case does not include the non-Committed Project
 - The change case includes the non-Committed Project
 - Gateway West without Midpoint-Hemingway #2, Cedar Hill-Midpoint and Populus-Borah
- b pRTP less Populus-Cedar Hill-Hemingway
 - pRTP less Populus-Cedar Hill-Hemingway plus Populus-Borah
- pRTP less Populus-Cedar Hill-Hemingway and Anticline-Populus
 The change case was run with and without B2H



Reliability/Stability Analysis Results

Presented by Chelsea Loomis, NTTG Planning Committee Chair



Reliability Analysis - Method

- Tune case to meet objectives (modified load in peak cases)
- Adjust reactive to meet voltage targets
- Testing each case with 480+ contingencies
- 170+ cases across the 8 powerflow conditions
- Export data for facilities (buses, lines, transformers, series caps) whose limits may potentially be exceeded.
 - Some limits may be exceeded for N-2 contingencies but not for N-1
 - Powerflow program doesn't distinguish between
 N-1s or N-2s (manually reviewed)



Reliability Analysis – Method (continued)

- 16500+ records where limits may potentially be exceeded
- The sheer number of values and cases made comprehending the results difficult. Review methods:
 - Pivot table of cases
 - Graphical



Reliability Pivot

	H	Heavy Sum	mer		Heavy Winter		Heavy Winter		Eastbound ID-N		Eastbound ID-NW		We	estbound I	D-NW				
		Limits	Un-		Limits	Un-		Limits	Un-		Limits Un-								
	CTG	Exceeded	solved	CTG	Exceeded	solved	CTG	Exceeded	solved	CTG	Exceeded	solved	Notes:						
Null	24	36	0	16	29	0	27	64	0		*		Case "I" requires local 230 kV lines to solve						
pRTP	10	15	0	12	17	0	11	29	0		* i		iRTP w/o Midpoint-Hemingway, Cedar Hill-Midpoint, Populus-Borah						
iRTP	10	15	0	12	18	0	10	30	0		*		All Gateway West In						
CC1	26	40	0	14	18	0	19	45	0		*		в2н						
CC2	12	17	0	*			*			*		Gateway South, Antelope Projects							
CC3	23	35	0		*			*			*		B2H, Gateway West(a)						
CC4	10	15	0		*		*		*			* F		*		B2H, Gateway West, Antelope Projects			
CC5	10	15	0		*			*			*		*		*		*		B2H, Gateway South, Antelope Projects
CC6	22	36	0	20	28	0	21	46	0		*		*		*		pRTP w/o Antelope		

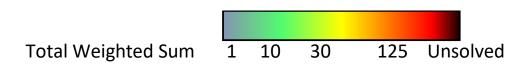
^{* -} Intentionally not Run

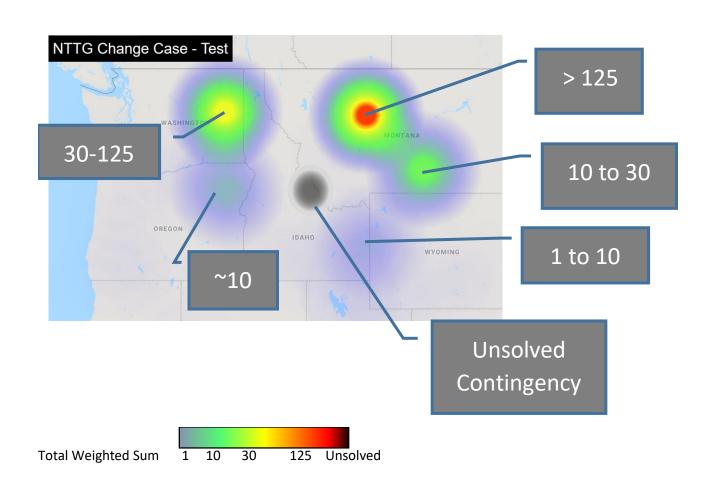
		High Tota	2	High	n Wyoming	Wind	Н	igh Borah \	Nest		Max Impo	rt	High	W&S Wyo	Export	
		Limits	Un-		Limits	Un-		Limits	Un-		Limits	Un-		Limits	Un-	
	CTG	Exceeded	solved	CTG	Exceeded	solved	CTG	Exceeded	solved	CTG	Exceeded	solved	CTG	Exceeded	solved	Notes:
Null	65	650	14	86	332	17	64	220	13	17	30	0	78	348	13	Case "I" requires local 230 kV lines to solve
oRTP	12	32	0	6	10	0	6	11	0	4	7	0	11	22	0	iRTP w/o Midpoint-Hemingway, Cedar Hill-Midpoint, Populus-Borah
RTP	15	35	0	5	9	0	6	11	0	4	7	0	12	27	0	All Gateway West In
CC1		*		76	289	15	57	175	15		*			*		В2Н
CC2	18	91	0	11	104	0		*			*		12	23	2	Gateway South, Antelope Projects
CC3	18	46	0	16	52	0		*			*		23	46	0	B2H, Gateway West(a)
CC4	12	80	0	9	92	0		*			*		16	36	2	B2H, Gateway West, Antelope Projects
CC5	12	78	0	10	75	0		*			*		14	29	2	B2H, Gateway South, Antelope Projects
CC6	16	37	0	8	12	0	8	13	0	12	21	0	20	40	0	pRTP w/o Antelope

^{* -} Intentionally not Run

- Compress the data differently:
 - Count the number of limit exceedances in each zone by:
 - High Voltages (1x)
 - Low Voltages (2x)
 - Overloads (5x)
 - This weights Overloads more severe than Low Voltages and Low Voltage as more severe than High Voltages
 - Sum the weighted values for each zone
 - Map Zone labels to Latitude and Longitude

- Create Heat Maps using the above data
 - Using a web browser with Java script and Google Maps to display
- Heat map Legend

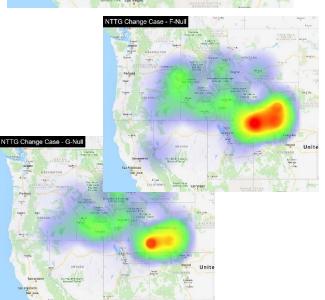


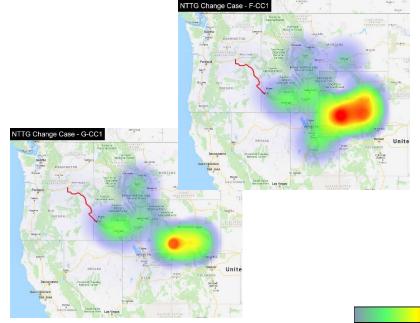




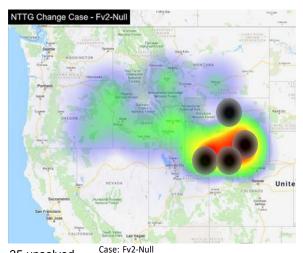


B2H resolves both eastbound and westbound ID-NW issues









35 unsolved

		Count of	Count of	Count of	
		High	Low		
Zones	¥	Voltage ▼	Voltage ▼	Overload: 🕶	Total ▼
Billings_MT				4	20
Butte_MT		4	15		34
Pac N of Path C				10	50
3 Mile Knoll_ID				3	15
Enterprise_OR				1	5
Harney_OR			8		16
Point of Rocks_WY		64	38	44	360
Bridger_WY				5	25
Hanna_WY		139	111	39	556
Miners_WY				16	80
Rock River_WY		18	6		30
Casper_WY		4		23	119
Melba_ID		2		2	12
John Day_OR			1		2
Twin Falls_ID		1		5	26
Hells Canyon_ID-OR			2		4

Times 1 Times 2 Times 5



Case: Fv2-pRTP

		Count of	Count of	Count of	
			Low		
Zones	w	Voltage 💌	Voltage 💌	Overload: *	Total
Burns_OR				1	5
		Times 1	Times 2	Times 5	

Gateway South or Gateway West in Wyoming is not sufficient, both required.







Populus-Hemingway is also needed







Case: Fv2-pRTP

Case: Fv2-CC31

		Count of	Count of	Count of	
			Low		
Zones	۳	Voltage 💌	Voltage 💌	Overload 💌	Tota ▼
Pac N of Path C		1		2	11
Twin Falls_ID				2	10
Mountain Home_ID				2	10
<u> </u>					

Times 1 Times 2

Count of Count of Count of High Zones ▼ Voltage ▼ Voltage Overload Tota Burns OR 1 5 Twin Falls ID 10 Mountain Home ID 10 Times 1 Times 2 Times 5

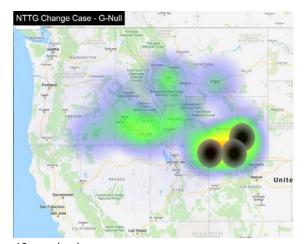
Case: Fv2-CC32

		Count of	Count of	Count of	
		High	Low		
Zones	~	Voltage 💌	Voltage 💌	Overload: *	Total
Burns_OR				1	5
		Times 1	Times 2	Times 5	

₩

Graphical Reliability Analysis

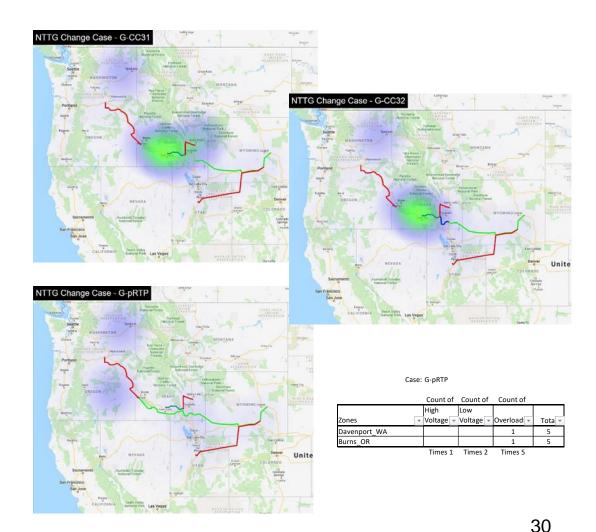
Populus-Hemingway needed to reinforce Borah West



13 unsolved Case: G-Null

	Count of	Count of	Count of	
	High	Low		
Zones	Voltage ▼	Voltage ▼	Overload -	Tota ▼
Billings_MT			4	20
Butte_MT	4	19		42
Pac N of Path C		3	7	41
Harney_OR		8		16
Point of Rocks_WY	25		63	340
Hanna_WY	11		10	61
Miners_WY			10	50
Casper_WY			6	30
Melba_ID	2			2
Twin Falls_ID	1		7	36
Mountain Home_ID			2	10
Hells Canyon_ID-OR		2		4

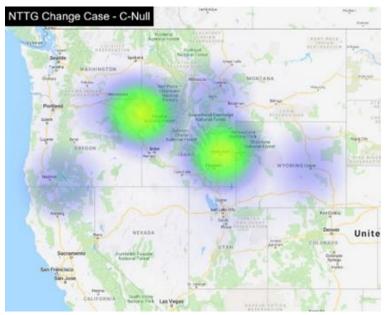
Times 1 Times 2 Times 5



Unsolved

1 10 30

125



Case: C-Null

		Count of	Count of	Count of	
		High	Low		
Zones	~	Voltage ▼	Voltage ▼	Overload 🔻	Tota ▼
Imnaha_OR				8	40
Butte_MT			4		8
Pac BPA Loads_ID				1	5
Pac N of Path C				12	60
Roundup_OR				1	5
Klamath Falls_OR		2			2
Medford_OR		1			1
Casper_WY				1	5
Arco_ID				1	5
Hells Canyon_ID-OR				7	35

Times 1 Times 2 Times 5



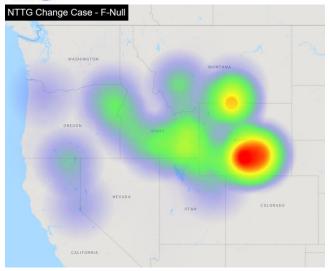
Case: C-pRTP

	Count of	Count of	Count of	
	High	Low		
Zones ▼	Voltage ▼	Voltage ▼	Overload: 🔻	Tota ▼
Pac N of Path C	1			1
Grants Pass_OR	1			1
Klamath Falls_OR	2			2
Medford_OR	1			1
Point of Rocks_WY			1	5

Times 1 Times 2 Times 5

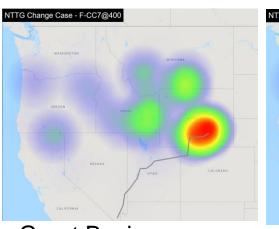


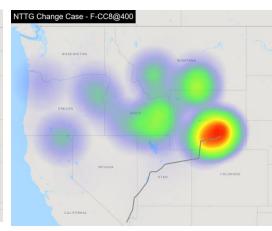
High Wyoming Wind



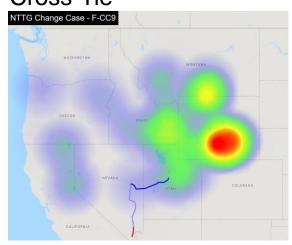
Do the ITPs provide NTTG benefit?

Added ITP without new TransWest Express

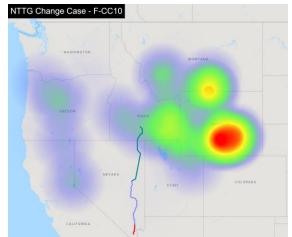


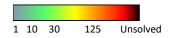


Cross-Tie



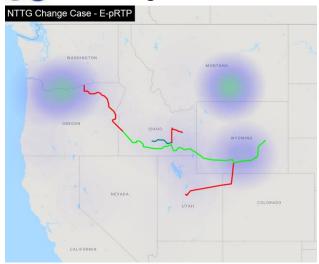
Great Basin



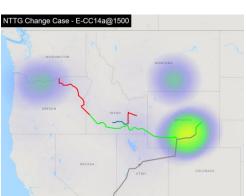


 The four ITPs do not materially displace the NTTG non-committed projects

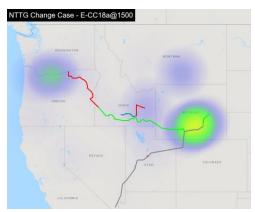
High Tot2 Case



Does the pRTP support the transfer of interregional Transfer of Interr



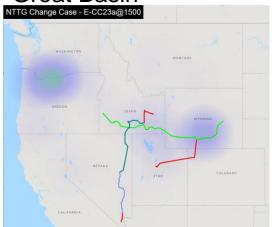
TransWest Express @1500

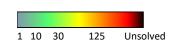


Cross-Tie @1500



Great Basin





Acceptable Configurations for Economic Evaluation

iRTP

pRTP











NTTG Metrics Evaluation and Draft Plan Results

Presented by John Leland, NTTG Technical Advisor



Metric Analysis

- Three Economic Metrics
 - Energy Losses, Reserves and Capital Related Costs
- Applied to the Non-Committed projects in
 - iRTP
 - B2H, McNary-Wallula, Gateway West, and Gateway South, Antelope Projects
 - pRTP
 - is the IRTP with Midpoint-Hemingway #2 500 kV, Midpoint-Cedar Hill 500 kV, Populus-Borah 500 kV project removed



Energy Loss Metric

- Energy Loss Metric
 - Captures the change in energy generated, based on system topology, to serve customer load
- Production Cost Modeling software
- Calculated 8760 hourly losses
- Annual Balancing Authority Area ("BAA") cost
 - Computed as the BAA MWh loss times BAA Average Locational Marginal Price \$/MWh



Reserve Metric

- This metric evaluates the opportunities for two or more parties to economically share a generation resource that would be enabled by transmission
- Spread sheet model
- NTTG footprint was segmented into zones
- Parties within the zones share a pro-rata portion of a simple cycle combustion turbine (priced at \$800/kw)



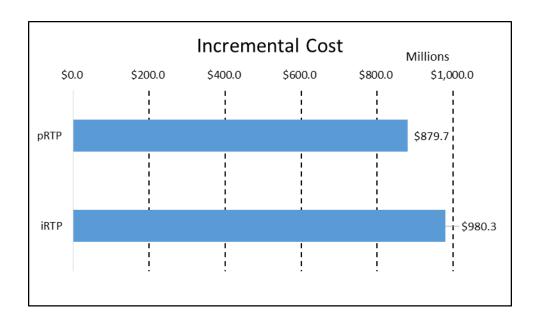
Capital Cost Metric

- This metric captures the extent that a project in the iRTP can be displaced (either deferred or replaced) while reliably meeting all regional transmission needs
- WECC Calculators and Spreadsheet Summary
- Steps
 - Estimate Non-Committee project capital cost
 - Validate sponsor's project cost submission
 - Compute Project Capital Related Costs
 - Develop iRTP and pRTP NPV Capital Related Cost
 - Develop Incremental Costs



Incremental Cost

- Compared iRTP and pRTP annualized incremental costs
- Incremental Cost is the sum of three annual metric results:
 - the capital related costs,
 - monetized energy loss benefit
 - monetized reserve benefit





Incremental Cost

 Based on the reliability and economic considerations the more efficient or cost-effective draft plan is the pRTP.

Annual Incremental Cost 2018\$

	11/16/2018	iRTP	pRTP	pRTP less iRTP
	Capital Related Cost	\$903,531,849	\$802,814,981	(\$100,716,868)
	Losses - Monitized	\$77,520,138	\$77,608,952	\$88,814
	Reserve - Monitized	(\$750,000)	(\$750,000)	\$0
	Incremental Cost	\$980,301,987	\$879,673,933	(\$100,628,054)

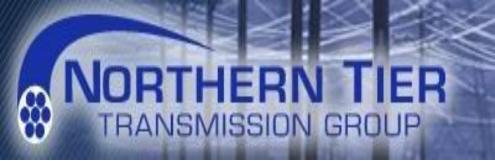
Draft Regional Transmission Plan

Based on the reliability and economic considerations the more efficient or cost-effective draft plan is the pRTP.









2018-2019 Draft Regional Transmission Plan Next Steps

Presented by Sharon Helms, NTTG Program Manager



Next Steps



 Once approved, the 2018-2019 NTTG Regional Transmission Plan will be posted on the NTTG website



Upcoming Meetings

- Monthly Planning Committee Meetings
- Four Quarterly Stakeholder Meetings
 - ✓ April 18, 2019, Portland, Oregon
 - ✓ June 21, 2019, Boise, ID
 - ✓ September 26, 2019, Bozeman, MT
 - ✓ December 5, 2019, Salt Lake City, UT

Date, Time and Location of these public meetings are posted on the Events Calendar on NTTG's website



Additional Information

Additional Information Regarding the Regional Planning Process can be Accessed at:

www.NTTG.biz



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