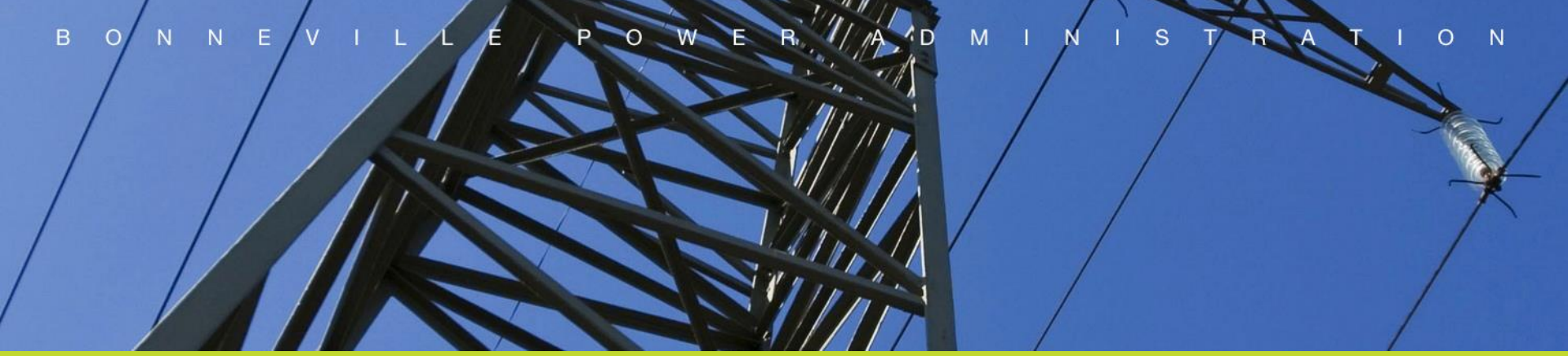


Bonneville Power Energy Imbalance Market Meeting

February 18, 2016

Future EIM Transmission Access Stakeholder Meetings in Portland at BPA's Rates Hearing Room:

Mar 30 – W
Apr 13 – W
May 19 – TH
June 9 – TH
July 26 – T
Aug 16 - T
Sept 22 – TH
Oct 27 – TH
Nov 14 – M
Dec 20 - T

Welcome

- Logistics
- Safety
- Introductions
- Agenda

Please sign-in by the entrance… Thank you

Agenda

- Overview and Discussion of:
  1. Curtailment Calculator
  2. Issues Log

Purpose of this Stakeholder Process

- Develop a risks and controls framework to assess risks to customers' existing and future transmission usage rights and evaluate the adequacy of existing BPA controls to protect those rights.

- Transparently develop a risk mitigation and control framework that ensures BPA meets its obligations and protects customer rights.

- Provide information to aid EIM Entities seeking to understand how they might be able to use their transmission rights on the Federal Columbia River Transmission System (FCRTS) if they were to join the California Independent System Operator Energy Imbalance Market (CAISO EIM).

Objectives

- Build understanding of EIM participant transmission use.
- Identify and manage risks for near-term EIM participant transmission use.
- Inform future planning and proceedings through a transparent process.
- Develop policies on the use of federal transmission for intra-hour operations.
- Consider the issues on an integrated, rather than case-by-case, basis.

Deliverables from this process

- Articulate a control framework and plan for monitoring and improvement.
  - Manage operational and commercial risks.
  - Identify areas for improvement.
- Validate effectiveness of EIM control framework.
  - Identify gaps and resolve as needed.
- Maintain a transparent set of rules for customers to use their transmission rights for EIM participation.

Understanding Curtailments

Network Curtailments 101

OBJECTIVES FOR TODAY'S DISCUSSION

- Understand the terms used in network curtailments
- Understand the steps leading up to a within-interval flowgate curtailment
- Understand the within-interval flowgate curtailment and redispatch process
- Understand how Firm PTP and Firm Network transmission participate in congestion relief

Terms

Flowgate - A mathematical construct, comprised of one or more monitored transmission Facilities and optionally one or more contingency Facilities, used to analyze the impact of power flows upon the Bulk Electric System. (From a portion of the Glossary of Terms Used in NERC Reliability Standards, January 29, 2016)

System Operating Limit (SOL) - The value (such as MW, MVar, Amperes, Frequency, or Volts) that satisfies the most limiting of the prescribed operating criteria for a specified system configuration to ensure operation within acceptable reliability criteria. (Glossary of Terms Used in NERC Reliability Standards, January 29, 2016)

Terms (Continued)

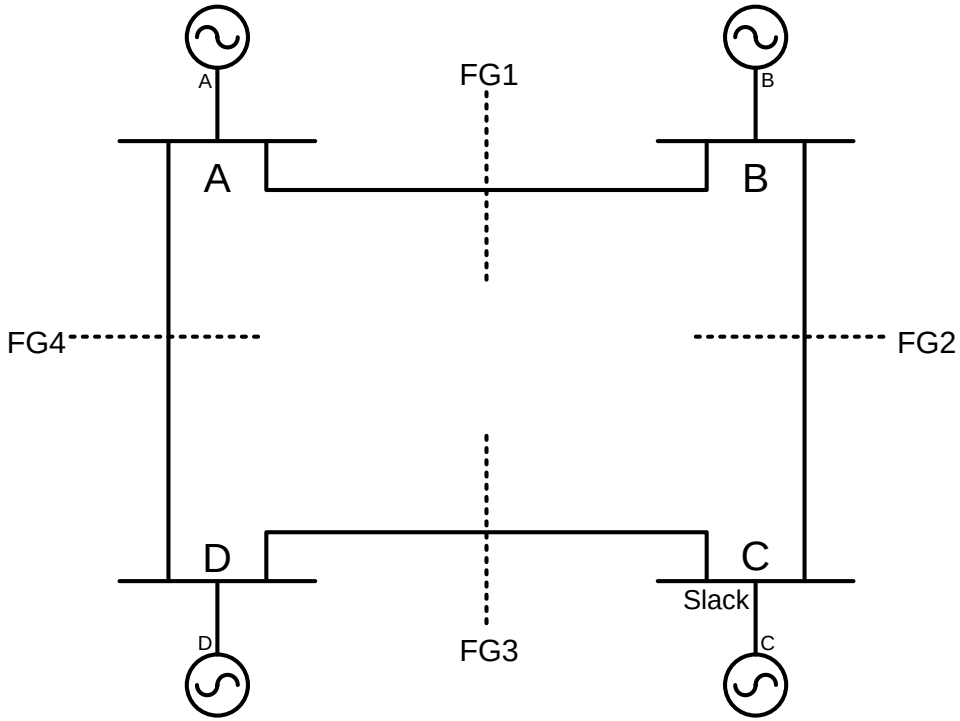
Shift Factor - A factor to be applied to a change in generation or load to determine the amount of flow contribution that change in output will impose on an identified transmission facility or Flowgate, relative to a reference point. (Paraphrase of Generator Shift Factor and Load Shift Factor from the Glossary of Terms Used in NERC Reliability Standards, January 29, 2016)

Distribution Factor - The portion of an Interchange Transaction, typically expressed in per unit that flows across a transmission facility (Flowgate) calculated by subtracting the POD Shift Factor from the POR Shift Factor. (Paraphrase of Distribution Factor from the Glossary of Terms Used in NERC Reliability Standards, January 29, 2016)

Network Model

- 4 Buses (A, B, C, D)
- 4 Resources* (A, B, C, D)
- 4 Transmission Lines (equal impedance)
- 4 Constraints (FG1, FG2, FG3, FG4)
- Slack = C

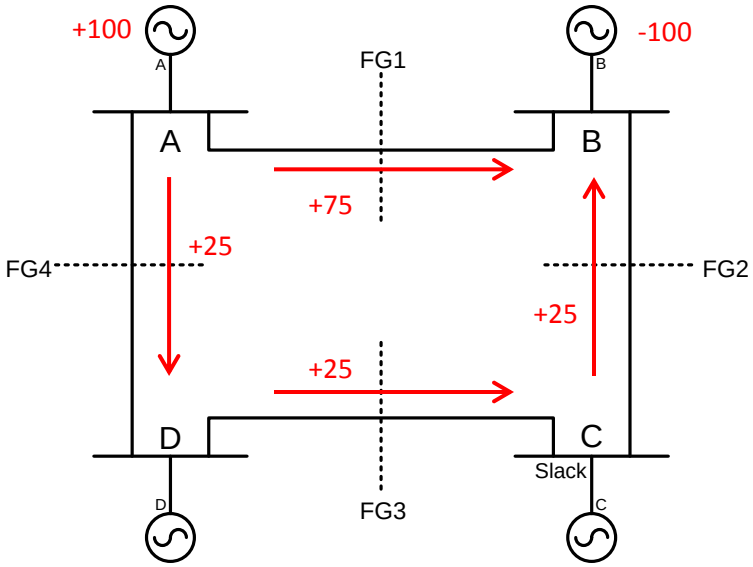
* Resources can be Generators or Loads



Shift Factors

- Used to assess the impact of injecting MWs at one bus and withdrawing them at a second bus
- Usually calculated in reference to a slack bus (C in our case)
- Linear and support superposition
- Example: How many MWs will flow on $FG3_{D-C}$ if you inject 100 MW at A and withdraw them at B?
  - $FG3_{D-C}$ = MWs * ($SF_{FG3:A}$ – $SF_{FG3:B}$) = 100 (0.5 - 0.25) = 25

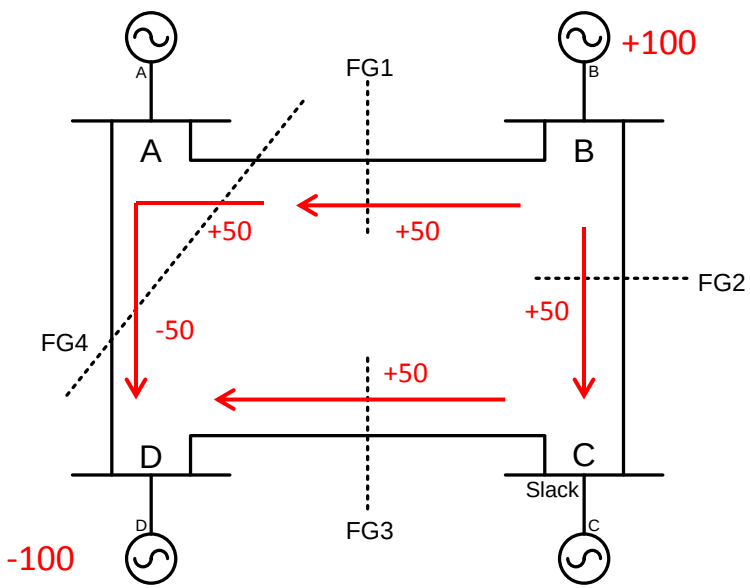
SHIFT FACTORS				
	RESOURCE			
FG	A	B	C	D
$FG1_{A-B}$	0.5	-0.25	0	0.25
$FG1_{B-A}$	-0.5	0.25	0	-0.25
$FG2_{B-C}$	0.5	0.75	0	0.25
$FG2_{C-B}$	-0.5	-0.75	0	-0.25
$FG3_{C-D}$	-0.5	-0.25	0	-0.75
$FG3_{D-C}$	0.5	0.25	0	0.75
$FG4_{D-A}$	-0.5	-0.25	0	0.25
$FG4_{A-D}$	0.5	0.25	0	-0.25



Shift Factors - FG4 now includes 2 lines

- FG4 bisects A-B and A-D
- New set of shift factors for FG4, the rest unchanged
- Example: How many MWs will flow on FG4 if you inject 100 MW at B and withdraw them at D?
  - $FG4_{A\rightarrow} = MWs * (SF_{FG4:B} - SF_{FG4:D}) = 100\ (0.0 - 0.0) = 0$

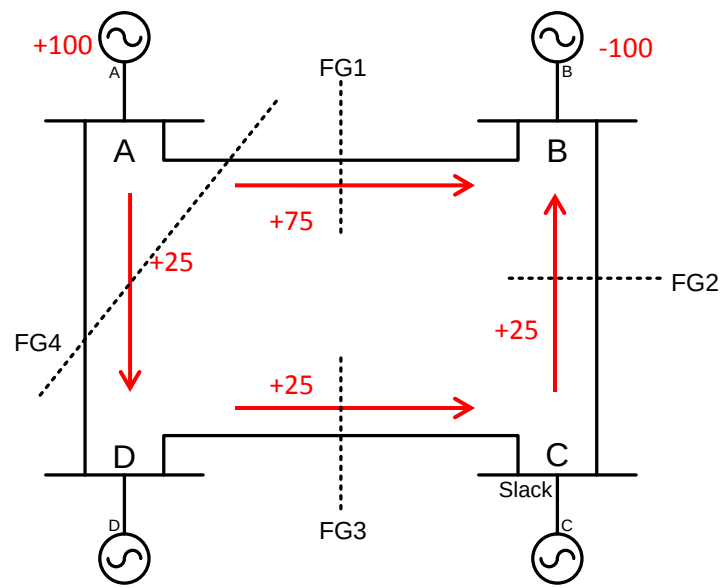
SHIFT FACTORS				
	RESOURCE			
FG	A	B	C	D
$FG1_{A-B}$	0.5	-0.25	0	0.25
$FG1_{B-A}$	-0.5	0.25	0	-0.25
$FG2_{B-C}$	0.5	0.75	0	0.25
$FG2_{C-B}$	-0.5	-0.75	0	-0.25
$FG3_{C-D}$	-0.5	-0.25	0	-0.75
$FG3_{D-C}$	0.5	0.25	0	0.75
$FG4_{A-->}$	1	0	0	0
$FG4_{A<--}$	-1	0	0	0



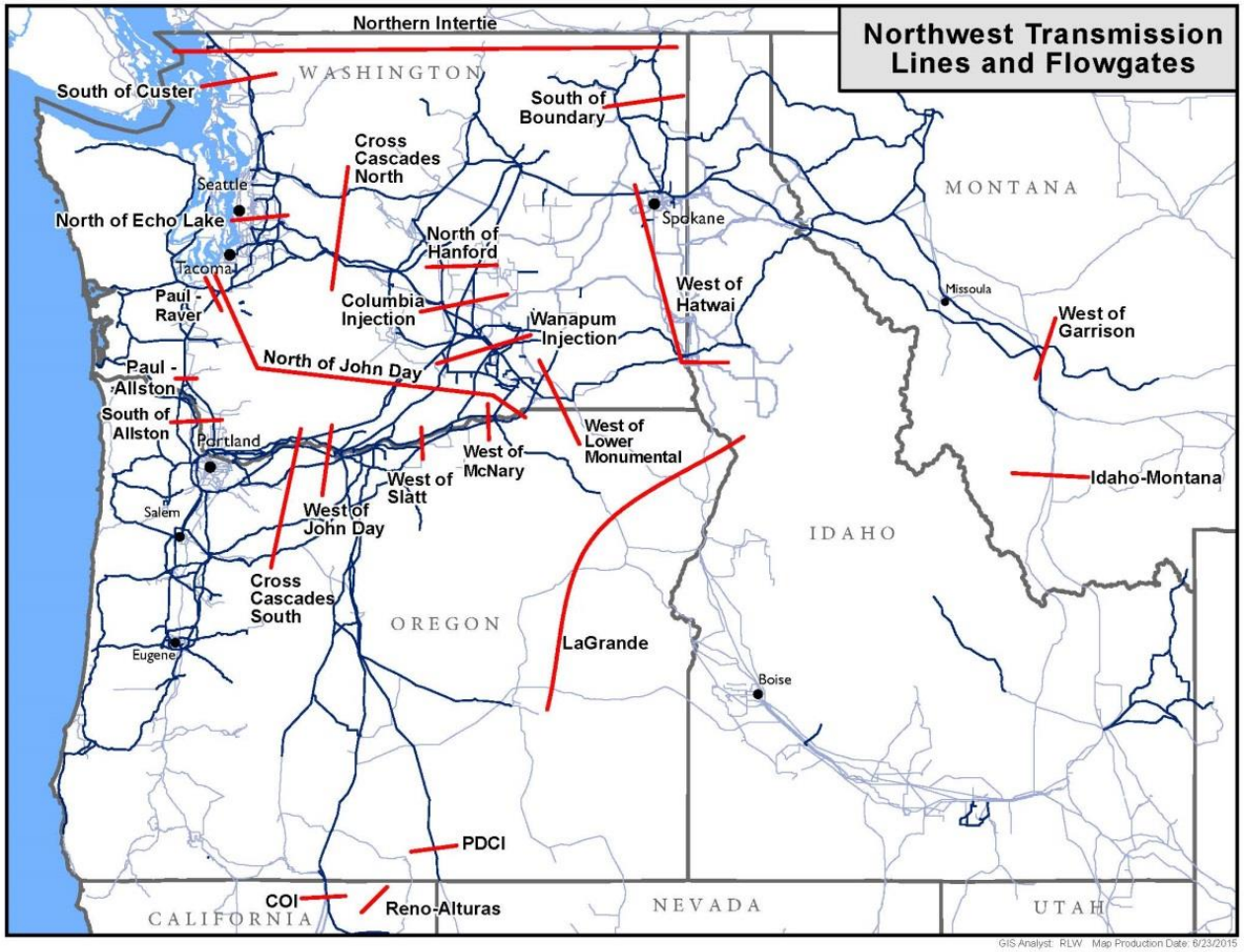
Shift Factors - FG4 (Continued)

- Example: How many MWs will flow on FG4 if you inject 100 MW at A and withdraw them at B?
  - $FG4_{A\rightarrow} = MWs * (SF_{FG4:A} - SF_{FG4:B}) = 100\ (1.0 - 0.0) = 100$

SHIFT FACTORS				
	RESOURCE			
FG	A	B	C	D
$FG1_{A-B}$	0.5	-0.25	0	0.25
$FG1_{B-A}$	-0.5	0.25	0	-0.25
$FG2_{B-C}$	0.5	0.75	0	0.25
$FG2_{C-B}$	-0.5	-0.75	0	-0.25
$FG3_{C-D}$	-0.5	-0.25	0	-0.75
$FG3_{D-C}$	0.5	0.25	0	0.75
$FG4_{A-->}$	1	0	0	0
$FG4_{A<--}$	-1	0	0	0



Not a 4-Bus System



The Flowgate Curtailment Process

Steps Leading Up To A Within-Interval Flowgate Curtailment

Multiple actions may be taken in advance of within-interval curtailment and redispatch. These actions include:

- Ahead of interval curtailments
- Switching actions
- AGC actions
- Limit wind to schedule
- Discretionary Redispatch

Within-Interval Flowgate Curtailment & Redispatch: Dispatch Initiation

Dispatch initiates a curtailment and redispatch by requesting the MW of relief needed.

- Determination that an SOL exceedance has occurred and a curtailment is necessary is identified in an application running on SCADA
- The MW of relief requested by Dispatch is generally higher than the SOL exceedance

CURTAILMENT FEATURES

Real-time outage-informed Shift Factors from the State Estimator.

All Non-Firm is curtailed, in priority order, before Firm.

Simultaneously calculate Firm PTP curtailments and Firm NT redispatch per Attachment M

- Pro-Rata based on contribution to flow
- Includes unscheduled NT impacts
- NT e-Tags (7-FN) are not curtailed

Calculating Relief

HOW RELIEF IS CALCULATED

All e-Tags having a Distribution Factor greater than 0.10 on the network flowgate are identified

E-Tags are sorted by NERC transmission priority: 1-NS, 2-NH, 6-NN, 7-F, and 7-FN (Firm Network)

Schedules within each priority, lowest priority first, are curtailed pro rata (by the same percentage) to get the necessary relief based on flowgate impact

If more relief is needed, then the next NERC transmission priority is curtailed pro rata until relief is achieved

CALCULATION EXAMPLE

Relief Needed = 76 MW

1. Retrieve Transactions (eTags)								
ID	**POR**	**POD**	**E-Tag MW**	**Product Code**	**POR Shift Factor**	**POD Shift Factor**	**Distribution Factor**	**Relief MW**
A	BC.US.Border	BPAT.PGEPOD	60	1-NS	0.06517	-0.33497	0.40014	24.0082
B	ChehalisPwr	BPAPower	50	1-NS	0.36190	-0.07776	0.43965	21.9826
C	Centralia	BPAT.PGEPOD	30	1-NS	0.33778	-0.33497	0.67275	20.1825
D	BPAT.PGEPOR	BC.US.Border	65	2-NH	0.46652	0.06517	0.40134	26.0874
E	BC.US.Border	BPAT.PGEPOD	25	2-NH	0.06517	-0.33497	0.40014	10.0034
F	WhtCrkWind	BC.US.Border	38	2-NH	0.32334	0.06517	0.25817	9.8103
G	CENTRALIA	PSEI.SYSTEMPOD	20	2-NH	0.33778	0.08438	0.25340	5.0681
2. Subtotal first priority block (1-NS) and compare with Relief Target (76 MW)								
Subtotal 1-NS = 24.0082 + 21.9826 + 20.1825 = 66.1733								
Subtotal 1-NS = 66.1733 < 76 = Relief Target								

Observations:

- There is ~66 MW of 1-NS
- By curtailing 100% of 1-NS, we will still not achieve our relief target of 76 MW

CALCULATION EXAMPLE (CONT.)

3. Curtail all 1-NS by 100%

ID	POR	POD	E-Tag MW	Product Code	Distribution Factor	Curtail %	MW to Curtail	Relief MW
A	**BC.US.Border**	**BPAT.PGEPOD**	**60**	**1-NS**	**0.40014**	**100.000%**	**60**	**24.0082**
B	**ChehalisPwr**	**BPAPower**	**50**	**1-NS**	**0.43965**	**100.000%**	**50**	**21.9826**
C	**Centralia**	**BPAT.PGEPOD**	**30**	**1-NS**	**0.67275**	**100.000%**	**30**	**20.1825**
D	BPAT.PGEPOR	BC.US.Border	65	2-NH	0.40134	0.000%	-	0.0000
E	BC.US.Border	BPAT.PGEPOD	25	2-NH	0.40014	0.000%	-	0.0000
F	WhtCrkWind	BC.US.Border	38	2-NH	0.25817	0.000%	-	0.0000
G	CENTRALIA	PSEI.SYSTEMPOD	20	2-NH	0.25340	0.000%	-	0.0000

4. Calculate Relief Needed

Relief Needed = Target - Current Relief = 76 - 66.1733 = 9.8267

Observations:

- After curtailing 100% of 1-NS, we will be left with 9.83 MW of additional relief needed
- We will need to go into the next priority level (2-NH)

CALCULATION EXAMPLE (CONT.)

5. Subtotal next priority block (2-NH)

Subtotal 2-NH = 26.0874 + 10.0034 + 9.8103 + 5.0681 = 50.9691

ID	POR	POD	E-Tag MW	Product Code	POR Shift Factor	POD Shift Factor	Distribution Factor	Relief MW
A	BC.US.Border	BPAT.PGEPOD	60	1-NS	0.06517	-0.33497	0.40014	24.0082
B	ChehalisPwr	BPAPower	50	1-NS	0.36190	-0.07776	0.43965	21.9826
C	Centralia	BPAT.PGEPOD	30	1-NS	0.33778	-0.33497	0.67275	20.1825
D	BPAT.PGEPOR	BC.US.Border	65	2-NH	0.46652	0.06517	0.40134	26.0874
E	BC.US.Border	BPAT.PGEPOD	25	2-NH	0.06517	-0.33497	0.40014	10.0034
F	WhtCrkWind	BC.US.Border	38	2-NH	0.32334	0.06517	0.25817	9.8103
G	CENTRALIA	PSEI.SYSTEMPOD	20	2-NH	0.33778	0.08438	0.25340	5.0681

6. Compare with Relief Needed

Subtotal 2-NH = 50.9691 > 9.8267 = Relief Needed

Observations:

- There is 50.97 MW of relief available from 2-NH

CALCULATION EXAMPLE (CONT.)

7.Calculate Curtail % for 2-NH block

Curtail % = 9.8267 / 50.9691 = **19.280%**

8. Distribute Curtail % and round **MW to Curtail** to nearest MW

ID	POR	POD	E-Tag MW	Product Code	Distribution Factor	Curtail %	MW to Curtail	Relief MW
A	BC.US.Border	BPAT.PGEPOD	60	1-NS	0.40014	100.000%	60	**24.0082**
B	ChehalisPwr	BPAPower	50	1-NS	0.43965	100.000%	50	**21.9826**
C	Centralia	BPAT.PGEPOD	30	1-NS	0.67275	100.000%	30	**20.1825**
D	**BPAT.PGEPOR**	**BC.US.Border**	**65**	**2-NH**	**0.40134**	**19.280%**	**13**	5.2175
E	**BC.US.Border**	**BPAT.PGEPOD**	**25**	**2-NH**	**0.40014**	**19.280%**	**5**	2.0007
F	**WhtCrkWind**	**BC.US.Border**	**38**	**2-NH**	**0.25817**	**19.280%**	**7**	1.8072
G	**CENTRALIA**	**PSEI.SYSTEMPOD**	**20**	**2-NH**	**0.25340**	**19.280%**	**4**	1.0136

9. Meet Relief Needed?

Subtotal 1-NS Relief = 66.1733

Subtotal 2-NH Relief = 10.0390

Total Relief = 76.2123 > 76

Relief Achieved

10. End

Observations:

- Since we only need an additional 9.83 MW of relief, we curtail each 2-NH transaction 19.28%
- We have achieved the relief needed of 76 MW

FIRM RELIEF

If relief is still needed after going through all Non-Firm buckets, then the curtailment moves into Firm Relief

Impacts of all 7-F transactions are put in one bucket and all 7-FN are put in another

Network customers' unscheduled load (Requirements load) have proxy schedules created as 7-FN

The proxies represent the load served by BPA Power Services and come from the Bonneville Agency Load Forecast

FIRM RELIEF (CONT.)

The remaining relief is allocated to each bucket according to the ratio of total Firm impact (i.e. pro-rata)

- The 7-F relief allocation is distributed to the 7-F transactions and those are curtailed
- The 7-FN relief allocation is given to Power Services as a NT Redispatch request

NT Redispatch is currently only requested of Federal Resources.

Power Services must comply with requests for NT Redispatch to the extent that it can do so without violating non-power constraints (From the BPA OATT)

Congestion Management for EIM Transfers

EIM Transfers are currently scheduled on PTP Firm transmission and are curtailed (limited) with other PTP Firm e-Tags.

During network curtailments, upper Variable Transfer Limits are reduced to zero, further limiting the impact of EIM Transfers.

BPAT and the CAISO have agreed on a principle that EIM transfers should not cause or exacerbate SOL exceedances.

Issues Log

	Question/Open Issue	Issue Category	Description	BPA Response	Validation	Timeline	Status
1	ATC	commercial access to transmission	Do BPA's Available Transfer Capacity planning processes adequately account for any changes?	BPA believes its ATC Planning processes adequately account for customers using Firm PTP transmission for EIM participation. BPA plans to discuss ATC-related questions in either the March or April including our Base Case assumptions and TSR evaluation.	Base Case/TSR Validation Discussion and how it applies to the EIM	Phase 1	Ongoing
2	System Scheduling	commercial access to transmission	Are there unique impacts of a PSE/PACW system-to-system schedule for EIM Transfers? Can BPA manage the impacts on this application of system-to-system scheduling?	EIM Participating Resources that use the FCRTS use source-specific schedules. In addition, real-time impacts are calculated using individual real-time shift factors (see also PTDF, PUF, etc.) for each relevant EIM Participating Resource based on then-current system topology. This is in addition to standard congestion management practices.	Overview of Tagging/Curtailmet/ UL Limits and how they apply to the EIM	Phase 1	Ongoing
3	Tariff and Business Practices	commercial access to transmission	Does BPA consider there to be any barriers created by its OATT, business Practices, contracts, or other documents that govern commercial access to transmission?	No. BPA believes that its transmission customers can use their standard PTP rights on the FCRTS using prevailing practices. BPA will continue to do a case-by-case analysis for any further entrants and such parties would be subject to any changes to practices that apply to all PTP customers. BPA has also identified *additional*requirements to mitigate any specific operationl issues created by the EIM.	BPA internal analysis. Communicated in stakeholder process	Phase 1	Resolved and Communicated

	Question/Open Issue	Issue Category	Description	BPA Response	Validation	Timeline	Status
4	DYNAMIC tags	commercial access to transmission	What are the impacts of using DYNAMIC tags on other customer's access to transmission? These tags encumber capacity based on Transmission Profile, not Energy Profile.	Use of the DYNAMIC tag type by BPA customers for the EIM are subject to the same standard as other customers in addition to the UL Limit and data requirements. Use of DYNAMIC tags for EIM flows does not have a unique impact.	Discussion on tagging requirements for EIM Transfers	Phase 2	Ongoing
5	NT Service	commercial access to transmission	Does expanded EIM participation impact service to NT customer's ability to serve load?	Controls are in place to manage the impacts of BPA customers using their Firm PTP rights on the FCRTS for the EIM. From TSR evaluation to congestion management and real-time controls for dynamic impacts. Thus far all use of the FCRTS for the EIM has been on Firm PTP TSRs greater than hourly. That practice is expected in the future. Further, any use of hourly Firm PTP would not have a unique impact.	Discussion on PSE transmission reservation use and evaluation	Phase 2	Ongoing
6	Transfer loads	commercial access to transmission	What are the impacts to BPA loads in PSE's BA?	BPA customers that have questions regarding Transfer Service should contact their Power Services AE.	Power Services, NW Requirements Marketing Issue. Contact your Power AE	NA	Ongoing
7	Allocation discussion for flowgate DTC.	commercial access to transmission	If BPA manages flowgate DTC based on totals how would it allocate among different users?	BPA is still developing the ability to set UL Limits based on system capability. At this point BPA sets the UL Limits based on a combination of Historic Use limits and provsional numbers for the purpose of identifying how they work. BPA does not believe this conversation is necessary until the UL Limit conrol framework evolves further. BPA has sole discretion of these values and can change them in real-time as it identifies the need to do so.	Transparent Policy Process when nomogram capability exists	Phase 2	Phase 2

	Question/Open Issue	Issue Category	Description	BPA Response	Validation	Timeline	Status
8	Long-Tem implications of providing DTC to customers for EIM participation	reliability and operations	How has BPA managed the long-term impact of DTC use for the EIM	BPA has not granted any long-term use of DTC to customers for EIM participation. EIM dispatches that utilize DTC are subject to UL Limits. BPA has sole discretion to set these values and can change them in real-time as it identifies the need to do so.	UL Limits Oveview	Phase 1	Ongoing
9	Staying within VTLs	reliability and operations	How does BPA ensure the CAISO stays within the VTLS and what is the method to resolveany non-performance?	BPA works closely with the CAISO and its customers to monitor performance within the UL Limit control framework. BPA has not yet identified the need to develop additional controls. BPA is working to develop additional monitoring capabilities. We are interested in customer feedback on the relative importance of this capability compared to other BPA priorities. BPA will discuss operation under these limits in upcoming stakeholder meetings.	UL Limit Overview/Performance/Rate Case	Phase 1	Ongoing
10	NT redispatch	reliability and operations	Will the CAISO account for congestion in the BPA BA when they dispatched? If so, how well? If not, Does the EIM lead to more NT Redispatch events	PAC and PSE will tag their transmission for the EIM on Firm PTP. See the ATC and congestion management discussion for a description of the standard practices BPA has in regards to Firm PTP transmission.There is no data that suggests an incremental need for network curtailments as a result of EIM participation. In addition, BPA's UL Limits account for congestion by limiting 5-minute dispatches when it enters a curtailment on a relevant flowgate.	Congestion Management Overview	Phase 1	Ongoing

	Question/Open Issue	Issue Category	Description	BPA Response	Validation	Timeline	Status
11	Curtailment priority	reliability and operations	What is BPA's curtailment priority of EIM dispatches?	BPA curtails tags used for EIM based on the its underlying transmission product (Firm PTP). BPA discussed the curtailment calculator in the February stakeholder meeting.	Congestion Management Overview	Phase 1	Ongoing
12	Impact of Pac's current use of DTC	reliability and operations	Overview of current operations	BPA will discuss operational data for the current implementation of EIM controls in Spring 2016	UL Limit Performance	Phase 1	Ongoing
13	How viable would a study be of EIM dispatch changes due to EIM? Do we have the proper inputs? DTC	reliability and operations	Can BPA study EIM dispatches and determine consumption of DTC and impacts on other uses?	BPA manages the use of DTC through its UL Limits. BPA has visibility over metered output of plants connected to the FCRTS and visibility of forecasted EIM market flow. BPA will discuss methods of monitoring actual performance.	UL Limit and Congestion Management Overview	Phase 2	Ongoing
14	Dynamic capabilities on BPA's system	reliability and operations	What is the DTC of BPA's system?	BPA is studying DTC on each of its network flowgates. BPA currently manages DTC use through UL Limits and has discretion to change the limits.	TIP 355	Phase 2	Ongoing

Questions….

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Future Stakeholder Meetings in Portland at BPA's Rates Hearing Room:

- Mar 30 – W
- Apr 13 – W
- May 19 – TH
- June 9 – TH
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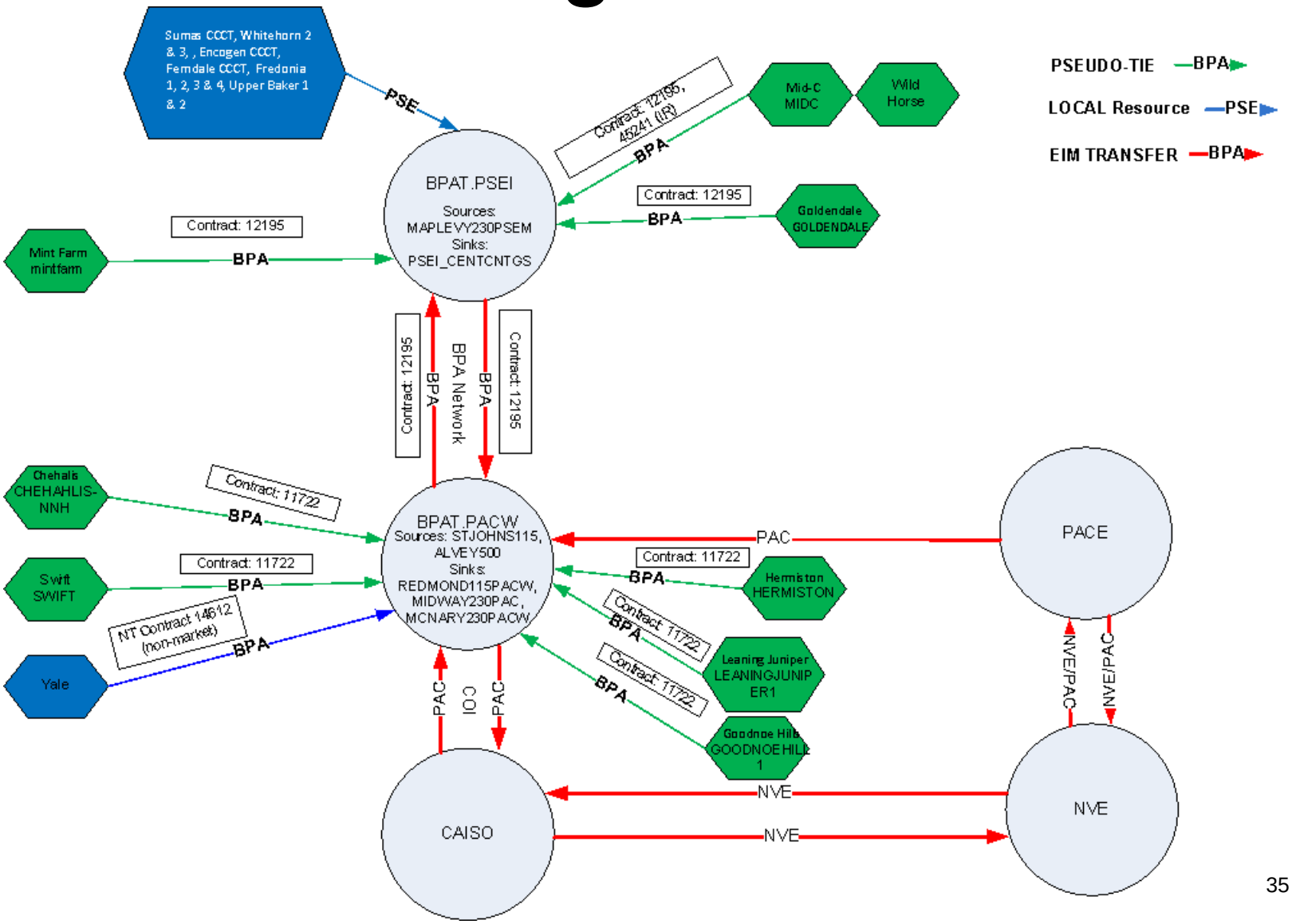
EIM Bubble Diagram



Description of EIM Movement

PSEUDO-TIE —BPA►

Delivery of PSE/PAC generator to the PSE BA over Firm BPA transmission via a PSEUDO-TIE tag. These tags and deliveries exist today for PSE/PAC's BA operation.

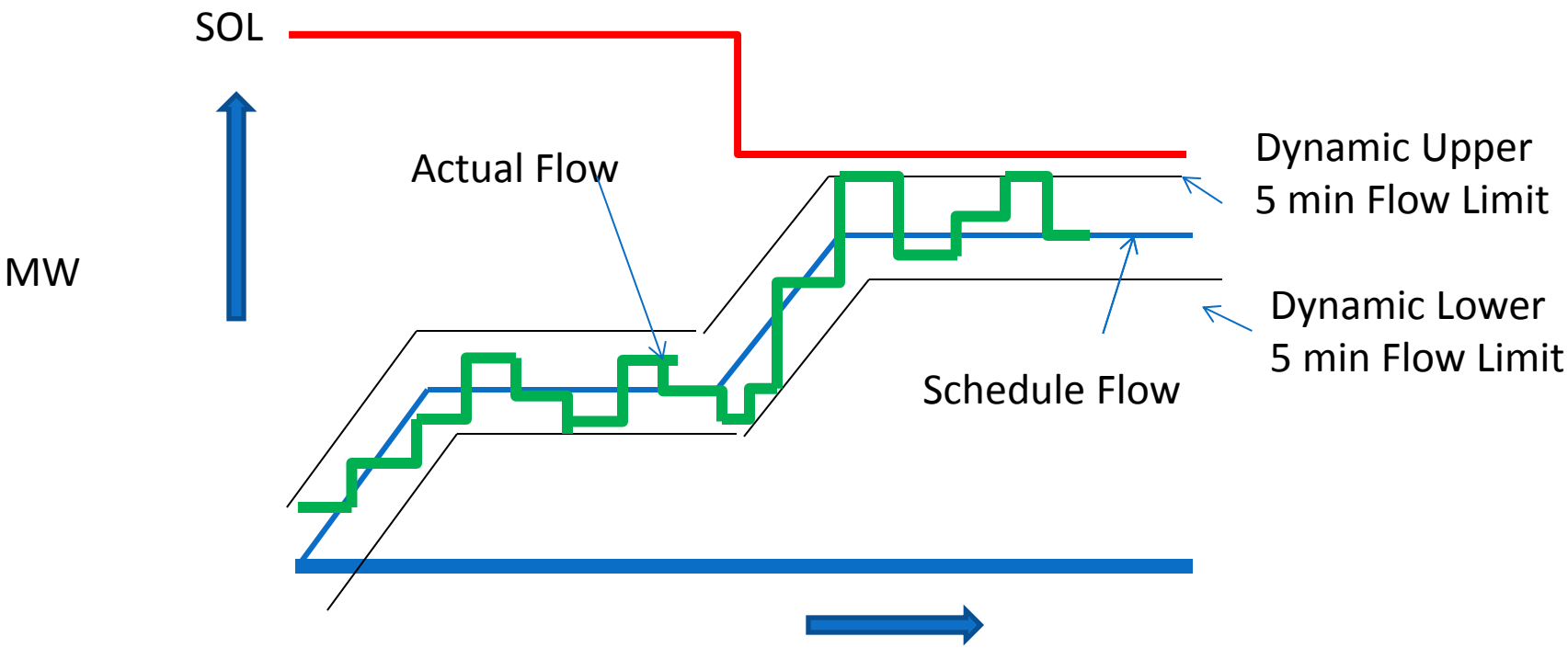
LOCAL Resource —PSE►

Generation that is "local" to the PSE/PAC BAs (i.e. it does not require BPA transmission to be delivered to PSE/PAC load).

EIM TRANSFER —BPA►

EIM Transfers represent the net market dispatch among the EIM Entity BAAs. These transfers exist today for PAC, but PAC uses its own transmission for these transfers. They are tagged as system to system and use NORMAL tags for 15-Minute dispatches and DYNAMIC tags for 5-minute dispatches.

Upper and Lower Limit Overview



Upper/Lower Limits are

Data Transfer in Support of Upper and Lower Limits

- BPA sends effective Upper and Lower Limits to the CAISO in real time.
- BPA receives data on the EIM in real-time
  - Advisory 5-minute and 15-minute dispatches
  - Binding 5-minute and 15-minute dispatches
  - Forecasted 5-minute and 15-minute Market Flow
  - Binding 5-minute and 15-minute Market Flow
  - Load forecasts for EIM Balancing Authority Areas
  - Unit status
  - Shift factors for EIM Participating Resources impacts on BPA's flowgates
  - Net Scheduled Interchange and load for EIM Balancing Authority Areas and CAISO

Schedule

Short-term Schedule: This process timeline is based on the go-live timeline for PSE.

	Start	Finish
BPA's EIM Participant - Transmission Access - Short-Term - Project Schedule	6/1/2015	10/3/2016
Section 23/EIM Transfer Issues	completed	
Use of Network (WECC) Model - CAISO accurately modeled our network	on-going w/ quarterly updates	
Stakeholder Process on EIM Implementation	8/17/2015	7/1/2016
Reimbursable Agreement	6/1/2015	12/11/2015
UL Limit Design	6/1/2015	9/15/2016
UL Limit Calculations	6/1/2015	7/1/2016
Data flows and Schedules	9/28/2015	9/28/2016
Provide Mechanism for how to transfer data (BPA--> CAISO)	10/1/2015	7/13/2016
Provide Mechanism for how to transfer data (CAISO --> BPA)	9/28/2015	9/28/2016
Market Constraints modeling	1/17/2016	3/28/2016
Study/Analysis of EIM and UL Limit Performance	1/1/2016	8/1/2016
Market Simulation Testing and Remediation	1/1/2016	9/1/2016
Market Simulation Begins	5/2/2016	9/1/2016
Production Readiness	Pre-PSE FERC filing	10/1/2016

Long-term Schedule: Allows BPA to develop new Business Practices that all EIM participants will follow. It will take into account the changing northwestern market.