

MOD-033

2024-01-24

WECC MVS Presentation

By: Ben Hutchins

*Image by DALL-E 3

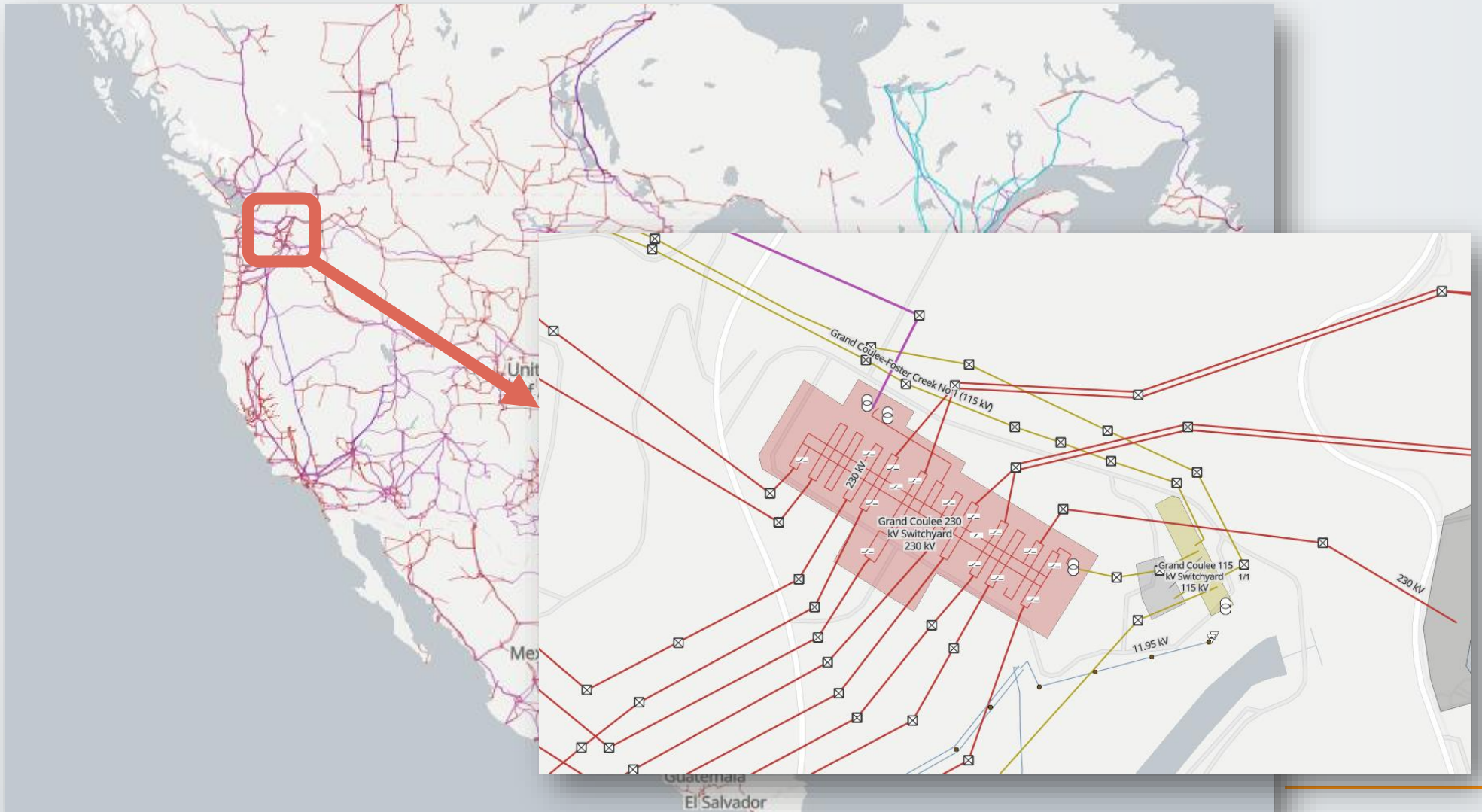


Goal

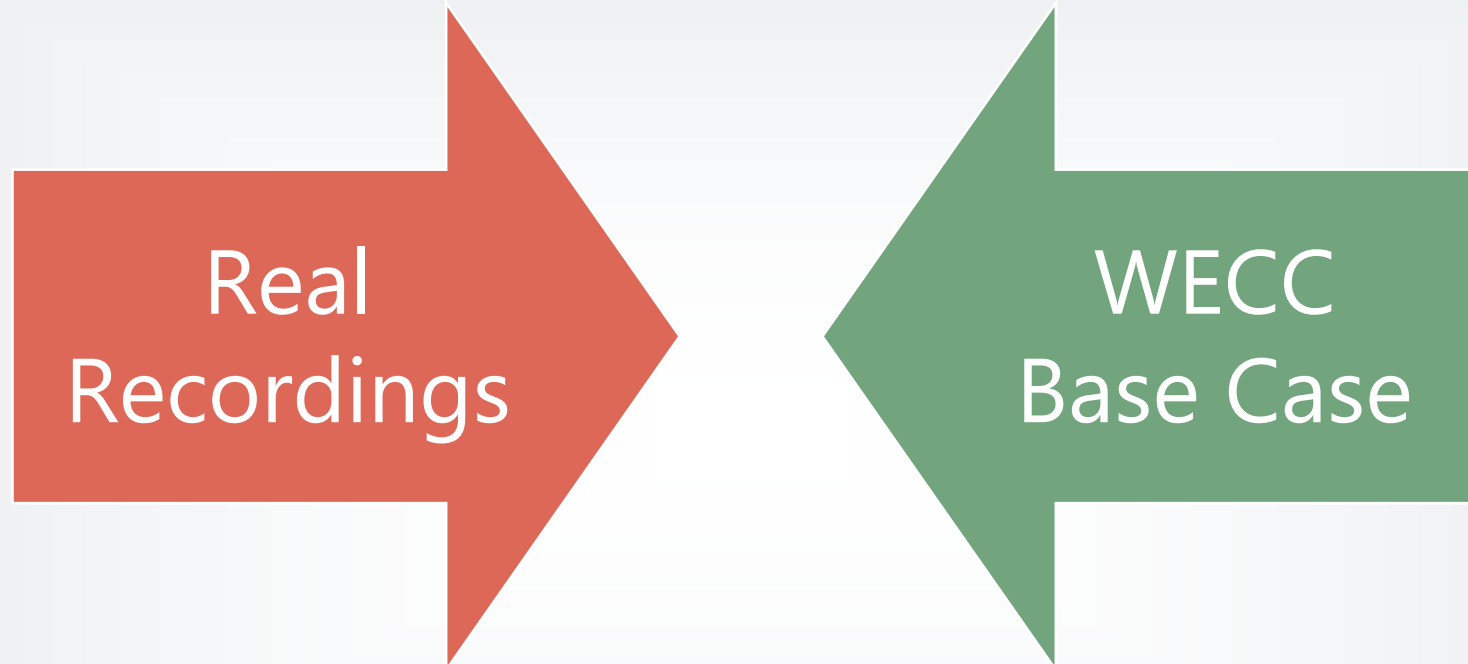
Save you time.

Quick Trick

» <https://openinframap.org/>



Purpose of MOD-033



Compare against reality.
Update models to improve accuracy.

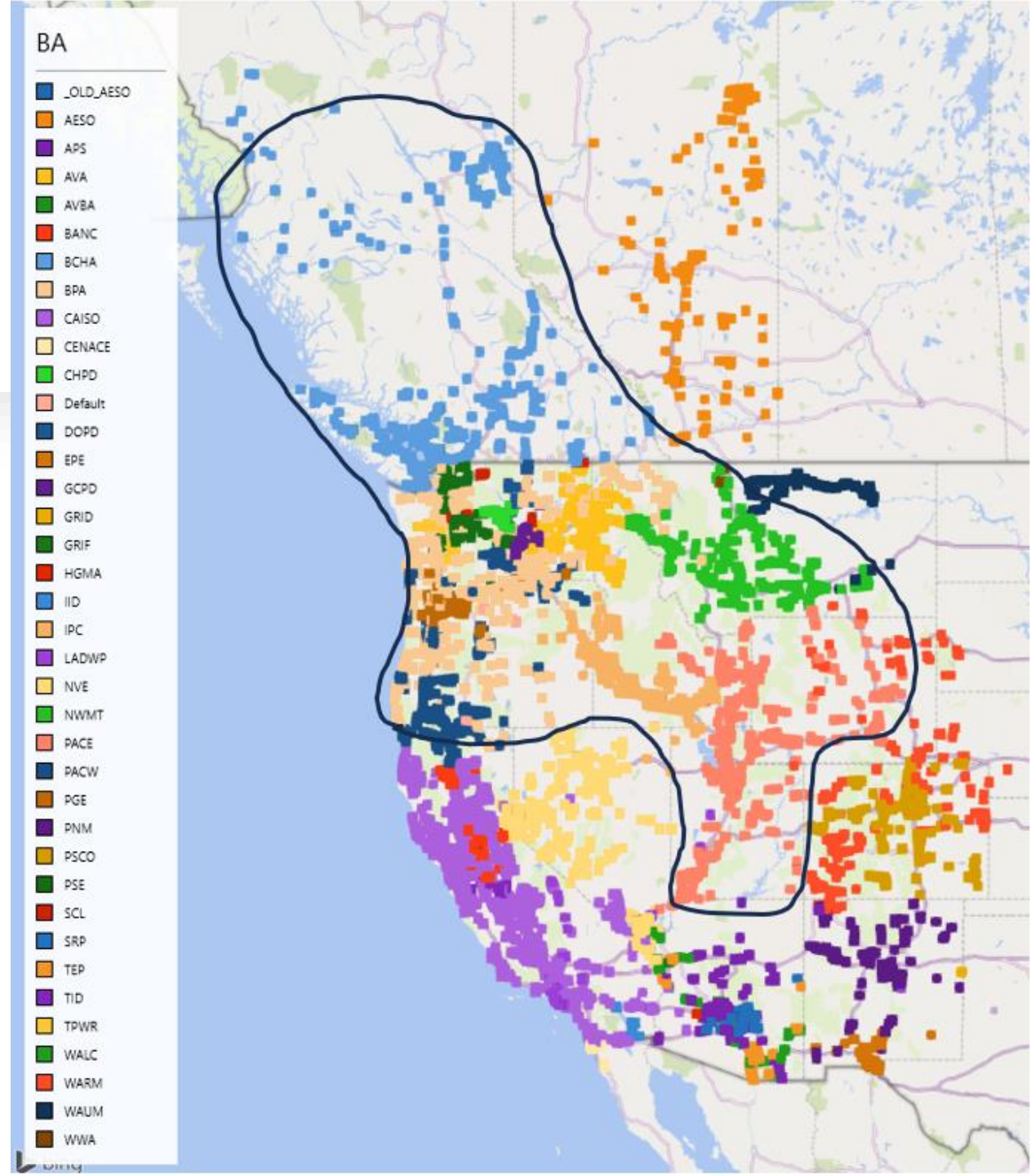
Requirements

- » Once every 2 years...
- » R1.1: Compare **Steady State**
- » R1.2: Compare **Dynamic**
- » R1.3: Have Guidelines to **Identify** Unacceptable **Differences**
- » R1.4: Have Guidelines to **Resolve** Unacceptable **Differences**
- » Scale loads/gen at least on a powerflow zone/area level

Footprint

14 BA Participants

- » Avista
- » BC Hydro
- » Bonneville Power Administration
- » Douglas County PUD
- » FortisBC
- » Grant County PUD
- » Idaho Power
- » NorthWestern Energy
- » PacifiCorp
- » Portland General Electric
- » Puget Sound Energy
- » Seattle City Light
- » Snohomish PUD
- » Tacoma Power

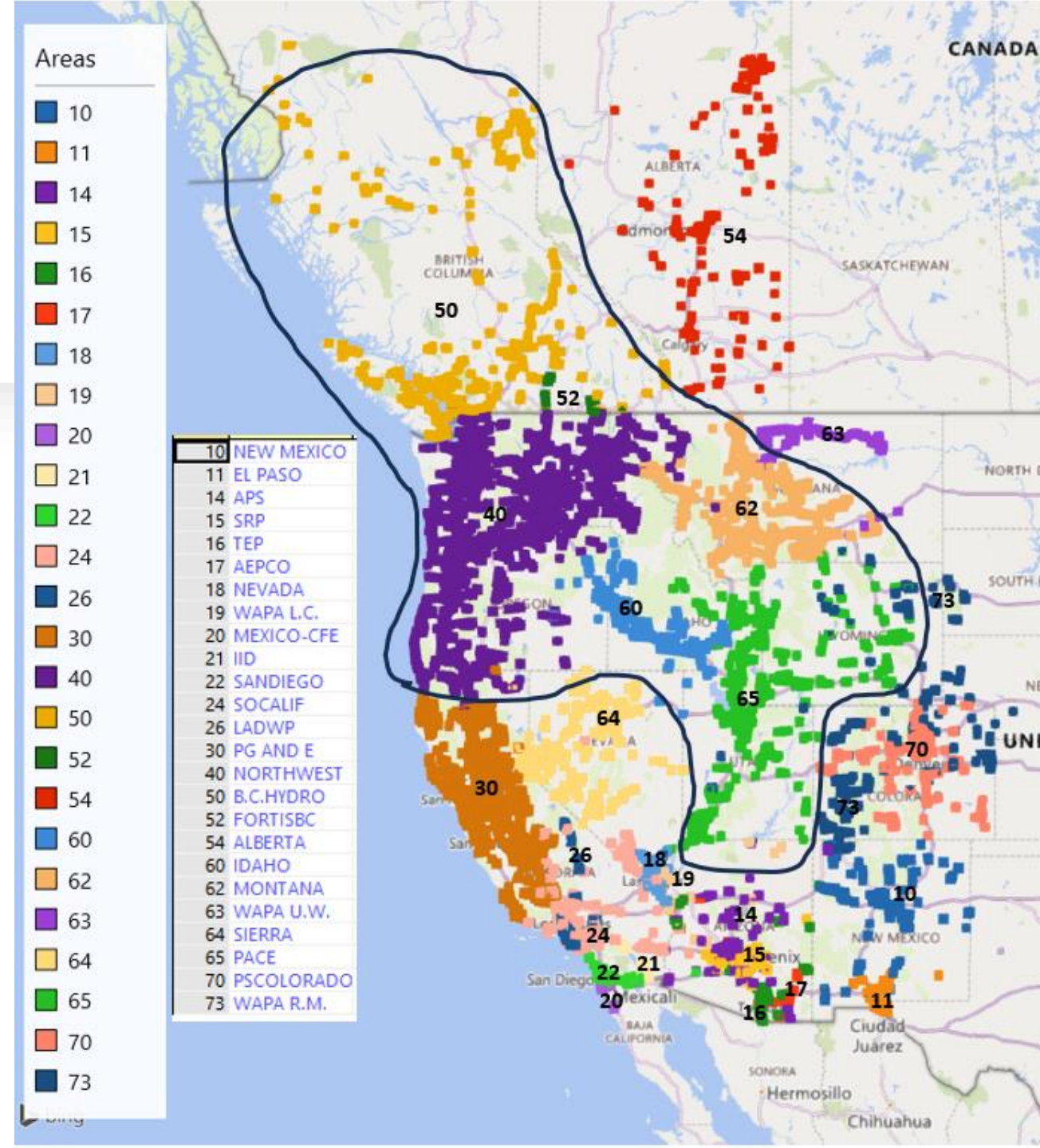


Footprint

**6 WECC Area #s
~40% of the
~25k Buses!**

» Areas:

- » 40 NORTHWEST
- » 50 BC HYDRO
- » 52 FORTIS BC
- » 60 IDAHO
- » 62 MONTANA
- » 65 PACE

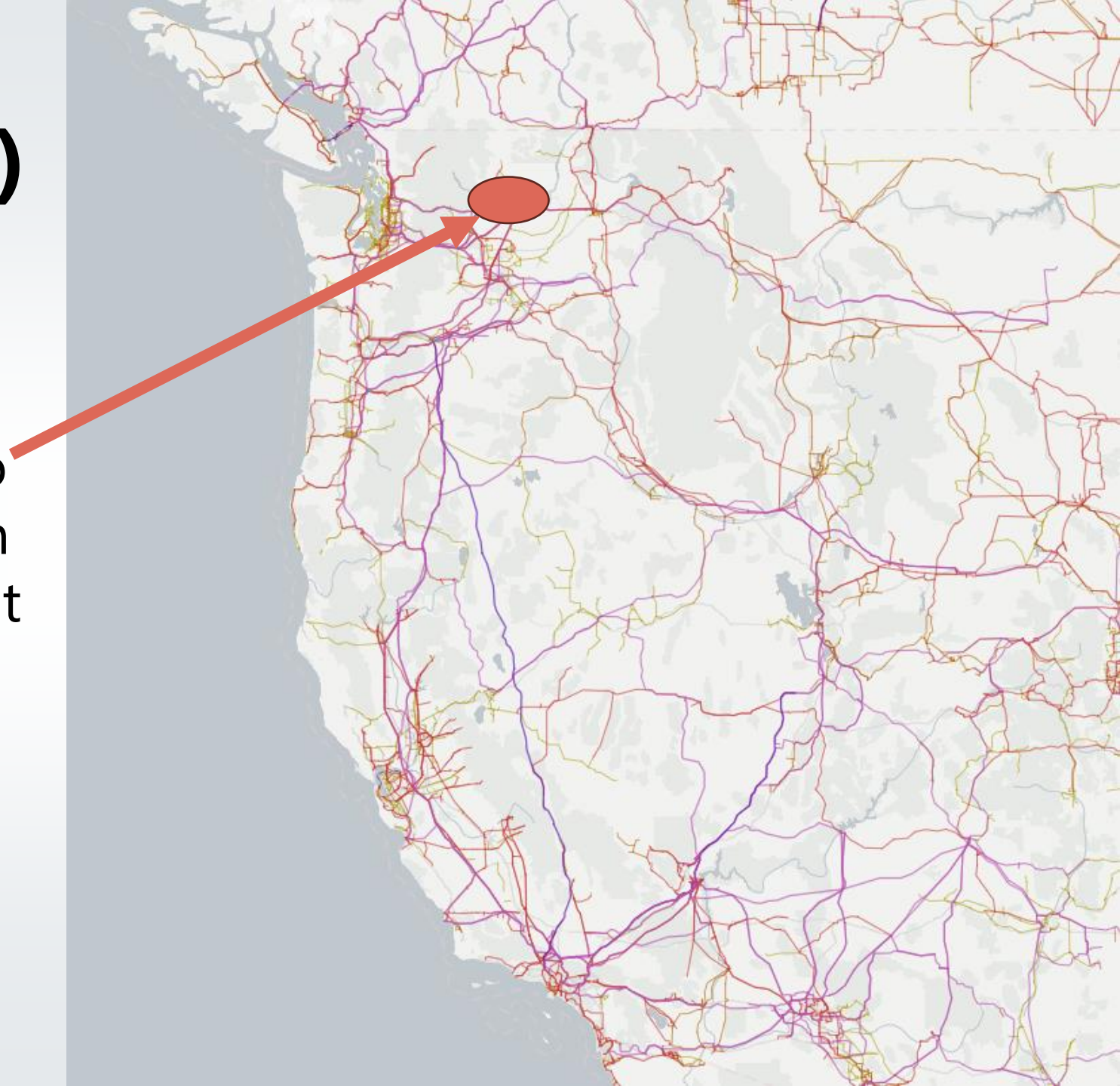


Event (Jan 2022)

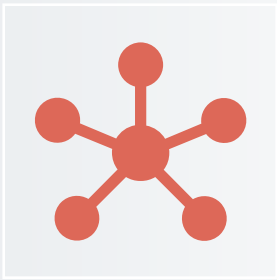
- » A 500kV line was opened for emergency maintenance.
- » A no-fault breaker failure occurred upon opening of the line.
- » After a series of automated events, multiple Hydro units disconnected.

Event (Jan 2022)

» RC West State Estimator showed between 1,800-1,900 MW of hydro generation opened, when comparing pre/post event snapshots.



System Data



Topology



State (Input)



State (Calculated)

Input

Output

Logistics – System Data

» Topology

- » Buses: Nominal kV
- » Lines: R, X, B
- » Transformers: R, X, B, G, MVA Base, Nominal kV, Fixed-Taps
- » Generators: Pmax, Qmin/Qmax (or Curves), MVA Base, *Vcontrol Bus
- » Loads: Bus & ID
- » Shunts: B, G
- » Dynamics Data

Logistics – System Data

» State (Input)

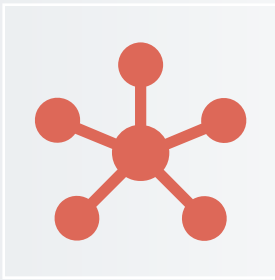
- » Lines: Status
- » Transformers: Status, Adjustable Voltage Taps
- » Phase Shifter: Status, Phase Angle Tap
- » Generators: Status, Pgen, *Voltage Setpoint
- » Loads: Status, MW, MVAR
- » Shunts: Status
- » DC Line Control Setpoints (Voltage, MW, MVAR)

Logistics – System Data

- » State (Calculated)
 - » Bus: Voltages & Angles
 - » Line/Transformer: MW & MVAR Flows

Process

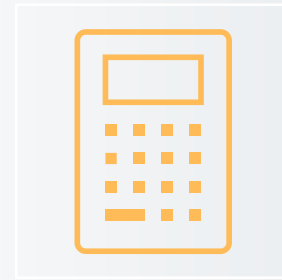
- » Update "State (Input)" values.
- » Check if "State (Calculated)" is the same as measured.
- » If yes, then the model adequately matches reality.



Topology



State (Input)



State (Calculated)

Input

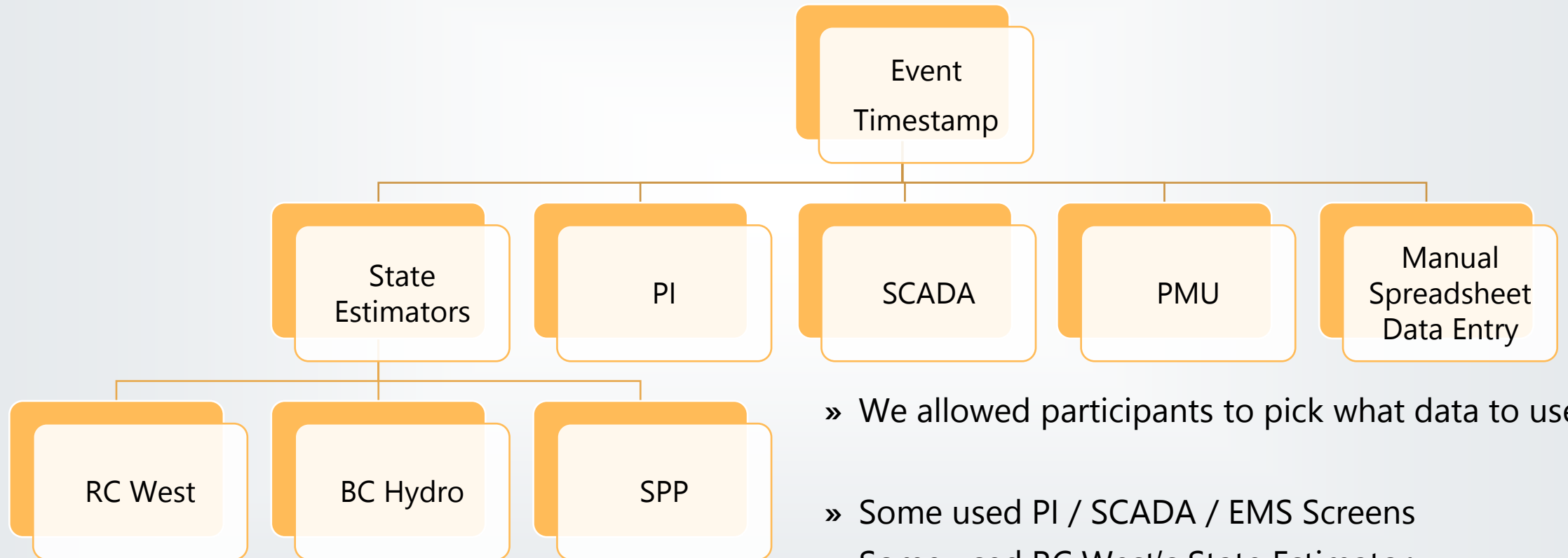
Output

Guidelines – To Identify Unacceptable Differences

	100-161 kV	230-345 kV	345 kV	≥ 500 kV
MW Flow (Lines and Transformers)	Greater of: +/- 10% measured flow or 10 MW	Greater of: +/- 10% measured flow or 20 MW	Greater of: +/- 10% measured flow or 50 MW	Greater of: +/- 10% measured flow or 100 MW
Bus Voltage	+/- 4%	+/- 3%	+/- 3%	+/- 2%

Table 3: Acceptable Performance Thresholds for Power Flow Model Comparison by Voltage Class

Data Sources – Mixed Sources



- » We allowed participants to pick what data to use.
- » Some used PI / SCADA / EMS Screens
- » Some used RC West's State Estimator

RC West

- » Models are in Breaker-Node Format.
- » They have tools in HANA to convert this to a bus-branch model, similar to the WECC topology, in a PSS/E RAW file.

(HANA Study participants; the full process is described in RC West documentation available to member utilities)

RC West

» CAISO has an RC Portal for MOD-033 data.

» Models are "On Request"

» *Note: Only "RC Entities" can get access to the RC Portal.*

AppsWorking GroupsLibrariesContact ListTrainingCalendar

HOME / LIBRARIES / SYSTEM MODEL VALIDATION

MOD-033 System Model Validation

Power flow and dynamic data for selected events are provided for System Model Validation.

Selected events include:

- Pre-contingency planning models that can be used by the Planning Coordinators (PCs) for further evaluation to meet MOD-033 compliance for each PC's jurisdictional area provided by WECC
- WECC-prepared power flow basecase, adjusted to specific system event for pre-contingency condition
- Switching file that includes switching sequence
- Dynamic data for performing dynamic simulation
- A limited number of PMU recordings

Not all of the WECC system events have the corresponding planning model's power flow and dynamic data.

Subscribe to MOD-033 System Model Validation library

All EntitiesAll Data TypeAll Years

Export to csv

Edit	Name	Title	Entity	Data type	Event date	Event area	Year	Modified on	Created on	A
	RC Operating Procedure RC0850	RC Operating Procedure RC0850	RC	Power Flow	2018-01-01	CAISO	2018	2018-01-01	2018-01-01	
	RC Operating Procedure RC0850	RC Operating Procedure RC0850	RC	Power Flow	2018-01-01	CAISO	2018	2018-01-01	2018-01-01	
	RC Operating Procedure RC0850	RC Operating Procedure RC0850	RC	Power Flow	2018-01-01	CAISO	2018	2018-01-01	2018-01-01	
	RC Operating Procedure RC0850	RC Operating Procedure RC0850	RC	Power Flow	2018-01-01	CAISO	2018	2018-01-01	2018-01-01	
	RC Operating Procedure RC0850	RC Operating Procedure RC0850	RC	Power Flow	2018-01-01	CAISO	2018	2018-01-01	2018-01-01	
	RC Operating Procedure RC0850	RC Operating Procedure RC0850	RC	Power Flow	2018-01-01	CAISO	2018	2018-01-01	2018-01-01	

REQUESTING SYSTEM BEHAVIOR DATA


RC Operating Procedure RC0850 outlines that Planning Coordinators can request system behavior data from RC West through the CIDI system as needed to perform a documented data validation process. Please select an RC Inquiry case record type and an RC Category of "MOD-033-1".

For entities that do not have access to the CIDI system, please submit the data request to ServiceDesk@caiso.com with "MOD-033" in the subject line. The Service Desk will create a CIDI ticket and assign to the CAISO engineering team. RC West will respond to the data requests through the CIDI system and post the system behavior data on this library. Please subscribe to alerts for this library if you would like to be notified when new files are posted or updated.

Addition Information

- Reliability Coordinator Procedure RC0850
- Training material for Steady-State and Dynamic System Model Validation: NERC MOD-033-1

Upload new document

 WPP

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RC West – RDFID

- » Buses are auto-numbered, except for the few that are mapped to WECC.
- » (It's hard to tell which ones those are, because the auto-numbering overlaps with many known WECC buses)
- » Bus-names get auto-numbered as well, depending on how many nodes there are in the export.


BUENVS 1
BUENVS 2
BUENVS 3
BUENVS 5
BUENVS 6
BUENVS 4
BUENVS 8
BUENVS 9

RC West - RDFID

```

49093      ' 1', 0.019800, 0.059100, 0.00740, 159, 142, 142,0.0000,0.0000,0.0000,0.0000,1,0.0000,1,1.00,0,0.00,0,0.00,0,0.00, /* [Compensator_
49094      ' 1', 0.001620, 0.002470, 0.00000, 46, 49, 49,0.0000,0.0000,0.0000,0.0000,1,0.0000,1,1.00,0,0.00,0,0.00,0,0.00, /* [_8784cd38-5b
49095      ' 1', 0.069420, 0.187080, 0.00213, 62, 62, 62,0.0000,0.0000,0.0000,0.0000,1,0.0000,1,1.00,0,0.00,0,0.00,0,0.00, /* [Conductor_10
49096      ' 1', 0.000510, 0.000560, 0.00000, 101, 108, 108,0.0000,0.0000,0.0000,0.0000,1,0.0000,1,1.00,0,0.00,0,0.00,0,0.00, /* [Compensator_
49097      ' 1', 0.069140, 0.180240, 0.00219, 62, 62, 62,0.0000,0.0000,0.0000,0.0000,1,0.0000,1,1.00,0,0.00,0,0.00,0,0.00, /* [Conductor_14
49098      ' 1', 0.020520, 0.102720, 0.00201, 118, 126, 126,0.0000,0.0000,0.0000,0.0000,1,0.0000,1,1.00,0,0.00,0,0.00,0,0.00, /* [_223dab82-f1
49099      ' 1', 0.031000, 0.084490, 0.01330, 86, 92, 92,0.0000,0.0000,0.0000,0.0000,1,0.0000,1,1.00,0,0.00,0,0.00,0,0.00, /* [Conductor_63
49100      ' 1', 0.005990, 0.028580, 0.00450, 159, 159, 159,0.0000,0.0000,0.0000,0.0000,1,0.0000,1,1.00,0,0.00,0,0.00,0,0.00, /* [Conductor_22
49101      ' 1', 0.015590, 0.031140, 0.00055, 58, 62, 62,0.0000,0.0000,0.0000,0.0000,1,0.0000,1,1.00,0,0.00,0,0.00,0,0.00, /* [Conductor_46

```



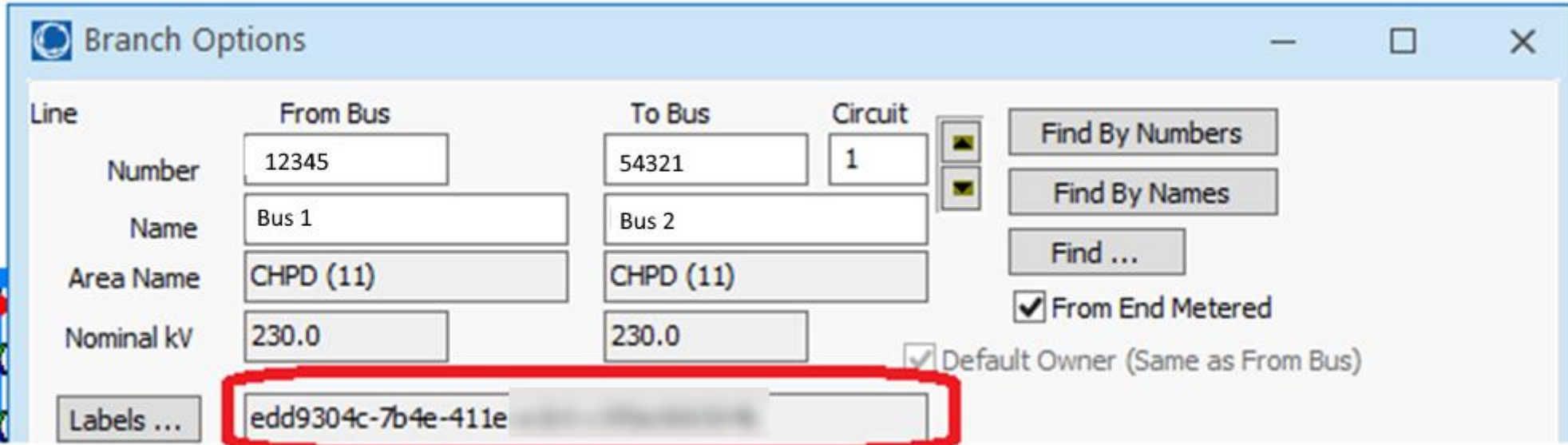
```

/* [Compensator_
/* [_8784cd38-5b
/* [Conductor_10
/* [Compensator_
/* [Conductor_14
/* [_223dab82-f1
/* [Conductor_63
/* [Conductor_22
/* [Conductor_46

```


RC West - RDFID

» PowerWorld reads these in as a "Label".



Branch Options

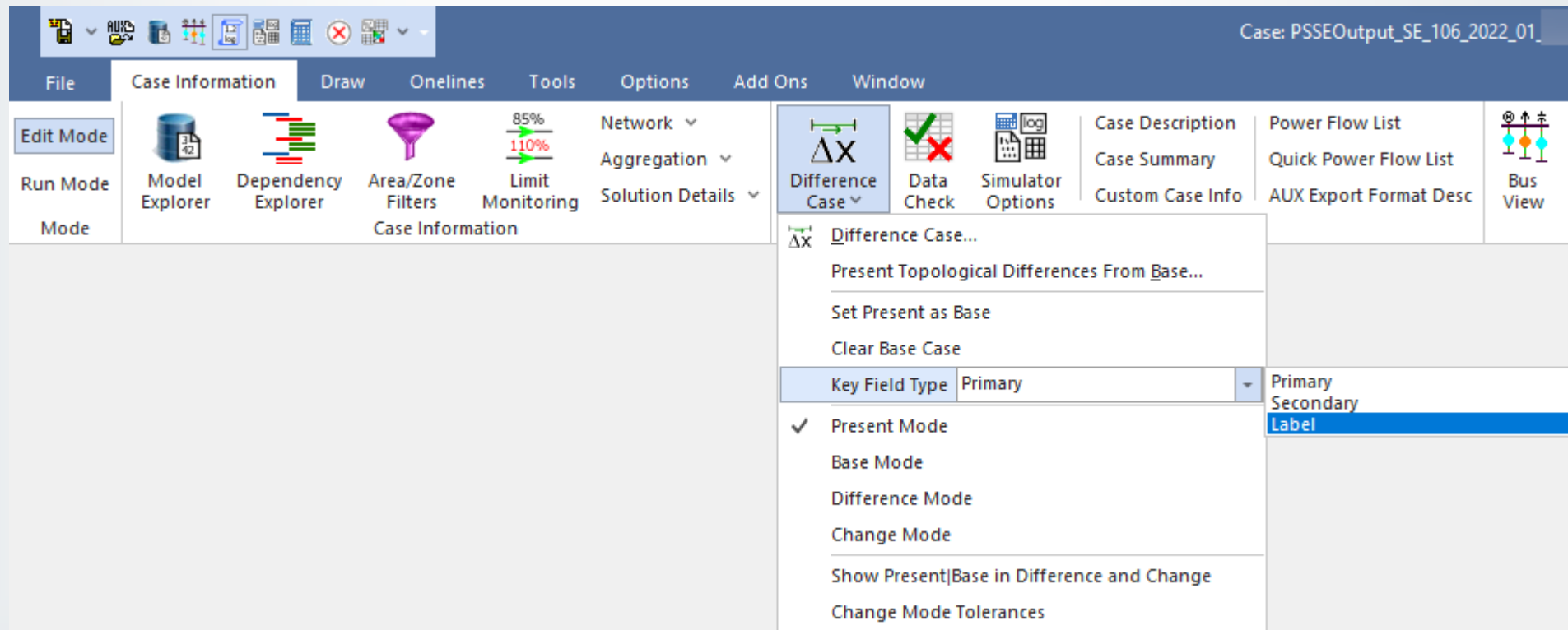
Line	From Bus	To Bus	Circuit
Number	12345	54321	1
Name	Bus 1	Bus 2	
Area Name	CHPD (11)	CHPD (11)	
Nominal kV	230.0	230.0	

Labels ... **edd9304c-7b4e-411e**

Find By Numbers
Find By Names
Find ...
☒ From End Metered
☒ Default Owner (Same as From Bus)

RC West - RDFID

» The Difference Tool allows you to use “Labels” to compare cases.



RC West – Pre/Post N-0 Solve

- » Open the RAW.
- » Click "Solve".
- » Look at line flows.
- » Notable differences in:
 - » CAISO
 - » BCHA

Model Explorer: Buses - Case: PSSE

File Case Information Draw Onlines Tools Options Add Ons Window

Edit Mode Run Mode Mode

Model Explorer Dependency Explorer Area/Zone Filters Limit Monitoring Case Information

Network Aggregation Solution Details

Difference Case Data Check Simulator Options

Case Description Case Summary Custom Case Info Case Data

Power Flow List Quick Power Flow AUX Export Form

Explore

Explore Fields

Recent

Network

Branches By Type

Branches Input

Branches State

Buses

DC Transmission Lines

Generators

Impedance Correction Tables

Line D-FACTS Devices

Line Shunts

Loads

Mismatches

Multi-Terminal DC

Switched Shunts

Three-Winding Transformers

Transformer Controls

Voltage Control Groups

Voltage Droop Controls

VSC DC Transmission Lines

Aggregations

Areas

Balancing Authorities

Bus Pairs

Data Maintainers

Injection Groups

Interfaces

Islands

Multi-Section Lines

Branches State

Buses

Records Geo Set Columns

Filter Advanced Branch Find... Remo

	From Number	From Name	From Nom kV	To Number	To Name	To Nom kV	Circuit	From Area Name	MW From
1			287.0			287.0	1	BCHA	-301.8
2			287.0			287.0	1	BCHA	-301.7
3			287.0			287.0	1	BCHA	-301.5
4			500.0			500.0	1	BCHA	-293.5
5			500.0			500.0	1	BCHA	-291.1
6			500.0			500.0	1	BCHA	-290.5
7			500.0			500.0	1	BCHA	-178.4
8			500.0			500.0	1	BCHA	-178.3
9			230.0			230.0	1	CISO	-176.9
10			1.0			500.0	1	BCHA	-148.3
11			1.0			500.0	1	BCHA	-145.4
12			500.0			500.0	2	BCHA	-131.7
13			500.0			500.0	1	BCHA	-130.5
14			500.0			500.0	1	BCHA	-99.7
15			500.0			500.0	1	BCHA	-97.3
16			500.0			500.0	1	BCHA	-96.7
17			500.0			500.0	1	BCHA	-95.4
18			500.0			500.0	1	BCHA	-93.5
19			500.0			500.0	1	BCHA	-90.9
20			1.0			500.0	1	CISO	-87.9
21			230.0			1.0	1	CISO	-87.9
22			500.0			500.0	2	CISO	-87.6
23			500.0			500.0	1	CISO	-87.6
24			500.0			500.0	1	CISO	-87.4
25			500.0			500.0	1	CISO	-87.4
26			500.0			500.0	1	CISO	-87.4
27			500.0			500.0	1	CISO	-87.4
28			230.0			1.0	1	CISO	-87.4
29			1.0			500.0	1	CISO	-87.4
30			287.0			287.0	1	BCHA	-70.2

RC West – Pre/Post N-0 Solve

» Which should you compare against?

» Pre-solve?

» Post-solve?

» They're different...

» WPP chose Post-Solve.

Model Explorer: Buses - Case: PSSE

File Case Information Draw Onlines Tools Options Add Ons Window

Edit Mode Run Mode Mode

Model Explorer Dependency Explorer Area/Zone Filters Limit Monitoring Case Information

Network Aggregation Solution Details

Difference Case Data Check Simulator Options

Case Description Case Summary Custom Case Info Case Data

Power Flow List Quick Power Flow AUX Export Form

Explore

Explore Fields

Recent

Network

Branches By Type

Branches Input

Branches State

Buses

DC Transmission Lines

Generators

Impedance Correction Tables

Line D-FACTS Devices

Line Shunts

Loads

Mismatches

Multi-Terminal DC

Switched Shunts

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Transformer Controls

Voltage Control Groups

Voltage Droop Controls

VSC DC Transmission Lines

Aggregations

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Balancing Authorities

Bus Pairs

Data Maintainers

Injection Groups

Interfaces

Islands

Multi-Section Lines

Branches State

Buses

Filter Advanced Branch

Find... Remo

	From Number	From Name	From Nom kV	To Number	To Name	To Nom kV	Circuit	From Area Name	MW From
1			287.0			287.0	1	BCHA	-301.8
2			287.0			287.0	1	BCHA	-301.7
3			287.0			287.0	1	BCHA	-301.5
4			500.0			500.0	1	BCHA	-293.5
5			500.0			500.0	1	BCHA	-291.1
6			500.0			500.0	1	BCHA	-290.5
7			500.0			500.0	1	BCHA	-178.4
8			500.0			500.0	1	BCHA	-178.3
9			230.0			230.0	1	CISO	-176.9
10			1.0			500.0	1	BCHA	-148.3
11			1.0			500.0	1	BCHA	-145.4
12			500.0			500.0	2	BCHA	-131.7
13			500.0			500.0	1	BCHA	-130.5
14			500.0			500.0	1	BCHA	-99.7
15			500.0			500.0	1	BCHA	-97.3
16			500.0			500.0	1	BCHA	-96.7
17			500.0			500.0	1	BCHA	-95.4
18			500.0			500.0	1	BCHA	-93.5
19			500.0			500.0	1	BCHA	-90.9
20			1.0			500.0	1	CISO	-87.9
21			230.0			1.0	1	CISO	-87.9
22			500.0			500.0	2	CISO	-87.6
23			500.0			500.0	1	CISO	-87.6
24			500.0			500.0	1	CISO	-87.4
25			500.0			500.0	1	CISO	-87.4
26			500.0			500.0	1	CISO	-87.4
27			500.0			500.0	1	CISO	-87.4
28			230.0			1.0	1	CISO	-87.4
29			1.0			500.0	1	CISO	-87.4
30			287.0			287.0	1	BCHA	-70.2

RC West – WECC Mapping

- » A comprehensive mapping does not exist (to our knowledge)
- » RC West has mapped 2/3rd of the generators (by Pmax) to WECC, in order to use WECC dynamics files.
- » For mapped gen-buses, the Bus #s will match WECC.
 - » Most other buses do not match – they are auto-numbered.
- » Load mapping does not exist.
- » RC West model Areas are BAs.
- » RC West model BAs do not appear to align well with the WECC BA definitions.

Areas Workaround – “Hole Punching”

- » This works especially well when you have “Contiguous” areas.
- » To get a rough WECC Area Definitions into an RC West case, you can “Hole Punch” areas by their tie-lines.

Areas Workaround – “Hole Punching”



Areas Workaround – “Hole Punching”

- » Example with Area 64 (Northern Nevada, “SIERRA”):
 - » Get a list of all Area 64 tielines in the WECC case.
 - » Find them in the RC West case, and open them.
 - » Click “Solve”.
 - » Look at the bus “Island Numbers” in PowerWorld.

Areas Workaround – “Hole Punching”

Model Explorer: Balancing Au

File Case Information Draw Onelines Tools Options Add Ons Window

Edit Mode Run Mode Mode

Model Explorer Dependency Explorer Area/Zone Filters Limit Monitoring Network Aggregation Solution Details Difference Case Data Check Simulator Options Case Description Case Summary Custom Case Info Case Data Power Flo Quick Pov AUX Expo

Explore

Explore Fields

- Recent
- Network
- Aggregations
 - Areas
 - Balancing Authorities
 - Bus Pairs
 - Data Maintainers
 - Injection Groups
 - Interfaces
 - Islands
 - Multi-Section Lines
 - MW Transactions
 - Nomograms
 - Owners
 - Substations
 - Super Lines
 - Tielines between Areas

Tielines between Areas (Filter:Quick)

Filter Advanced AreaTieLine Quick Find... Remove Q

	Tie Type	Near Name_Nominal kV	Far Name_Nominal kV	Ckt	Near Ar Name	Far Area Name
1	Branch (Line)	RSHASC1_500.0	ROBINSON_500.0	1	NEVADA	SIERRA
2	Branch (Line)	NEVBD501_55.00	TAP642_55.00	1	SIERRA	SOCALIF
3	Branch (Line)	NEVBD502_55.00	TAP645_55.00	1	SIERRA	SOCALIF
4	Branch (Line)	GONDER_230.0	INTERMT_230.0	1	SIERRA	LADWP
5	Branch (Line)	SUMMIT_3_60.00	SUMMIT_60.00	1	SIERRA	PG AND E
6	Branch (Line)	SUMMIT_1_115.0	DRUM_115.0	1	SIERRA	PG AND E
7	Branch (Line)	SUMMIT_2_115.0	DRUM_115.0	1	SIERRA	PG AND E
8	Branch (Transformer)	MARBLE_63.00	MARBLE_69.00	1	SIERRA	PG AND E
9	Branch (Transformer)	HIL TOP1_50.00	HILL TOP_230.0	1	SIERRA	NORTHWEST
10	Branch (Line)	IDAHO-NV_345.0	MIDPOINT_345.0	1	SIERRA	IDAHO
11	Branch (Line)	UTAH-NEV_230.0	BLACKROC_230.0	1	SIERRA	PACE

Area 64 Ties
Open them all

Areas Workaround – “Hole Punching”

Model Explorer: Buses - Case: 22HW2a1_Original_WECC_Case.pwb Status: Running (PF) | Simulator 23

File Case Information Draw Onelines Tools Options Add Ons Window

Edit Mode Run Mode Mode

Model Explorer Dependency Explorer Area/Zone Filters Monitoring Limit Solution Details Difference Case Data Check Simulator Options Case Description Case Summary Power Flow List Quick Power Flow List Custom Case Info AUX Export Format Desc Case Data Bus View Substation View Online Viewer Data View Open Windows

Explore

Explore Fields

Recent Network

Branches By Type

Branches Input

Branches State

Buses

DC Transmission Lines

Generators

Impedance Correction Tables

Line D-FACTS Devices

Line Shunts

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Three-Winding Transformers

Transformer Controls

Voltage Control Groups

Voltage Droop Controls

VSC DC Transmission Lines

Aggregations

Areas

Balancing Authorities

Buses

Area Tielines

DC Lines

Areas

Balancing Authorities

Name Nom kV Island Number

681 WESTSIDE 63.00 2

682 LAST CHANCE 120.00 2

683 MCDERMIT_SS 115.00 2

684 CENTENNIAL 63.00 2

685 CAITHNES 120.00 2

686 FT CH PS 120.00 2

687 SWITCH 120.00 2

688 LOCKE 57.50 2

689 CROSSROADS 120.00 2

690 MILESCITYW 230.00 2

691 LOUDON_H 12.50 1

692 ROSEBUDMD 230.00 1

693 HOT_SPRG 115.00 1

694 SYL PF BUS 2 230.00 1

695 JOV-U1 18.00 1

696 MARADE11 500.00 1

697 EL_CABO_1 0.6900 1

698 WPHXAPSS 230.00 1

699 ED-5 115.00 1

700 JOV-U2 13.80 1

701 WINDGAP1 13.20 1

702 WHLR RD2 13.20 1

703 SANLUCAS 115.00 1

704 HAD_C 21.50 1

Display/Column Options: Bus

Column Options Display Options Data View Layouts

Available Fields Find Field...

Calculated Field

Contingency Analysis

Contingency Results

Custom

Data Check

Data Maintainer

Difference Case

Dummy Bus

EPC File

Equivalencing

Fault Analysis

Generators

Geography

Geomagnetically Induced Current

Island

Number

Solved

Labels

Add ->

<- Remove

Move Up

Move Down

Highlight

Color Enterable

Show these fields in this order

Name

Voltage\kV Nominal

Island\Number

Labels\Labels All

Area\Name

Voltage\Per Unit Magnitude

Voltage\kV Actual

Voltage\Angle (degrees)

Loads\MW

Number

Loads\Mvar

Generators\MW

Generators\Mvar

Switched Shunts\Mvar

Bus Shunt\MW - Actual (G)

Bus Shunt\Mvar - Actual (B)

Area\Number

Zone\Number

Show Column Headers

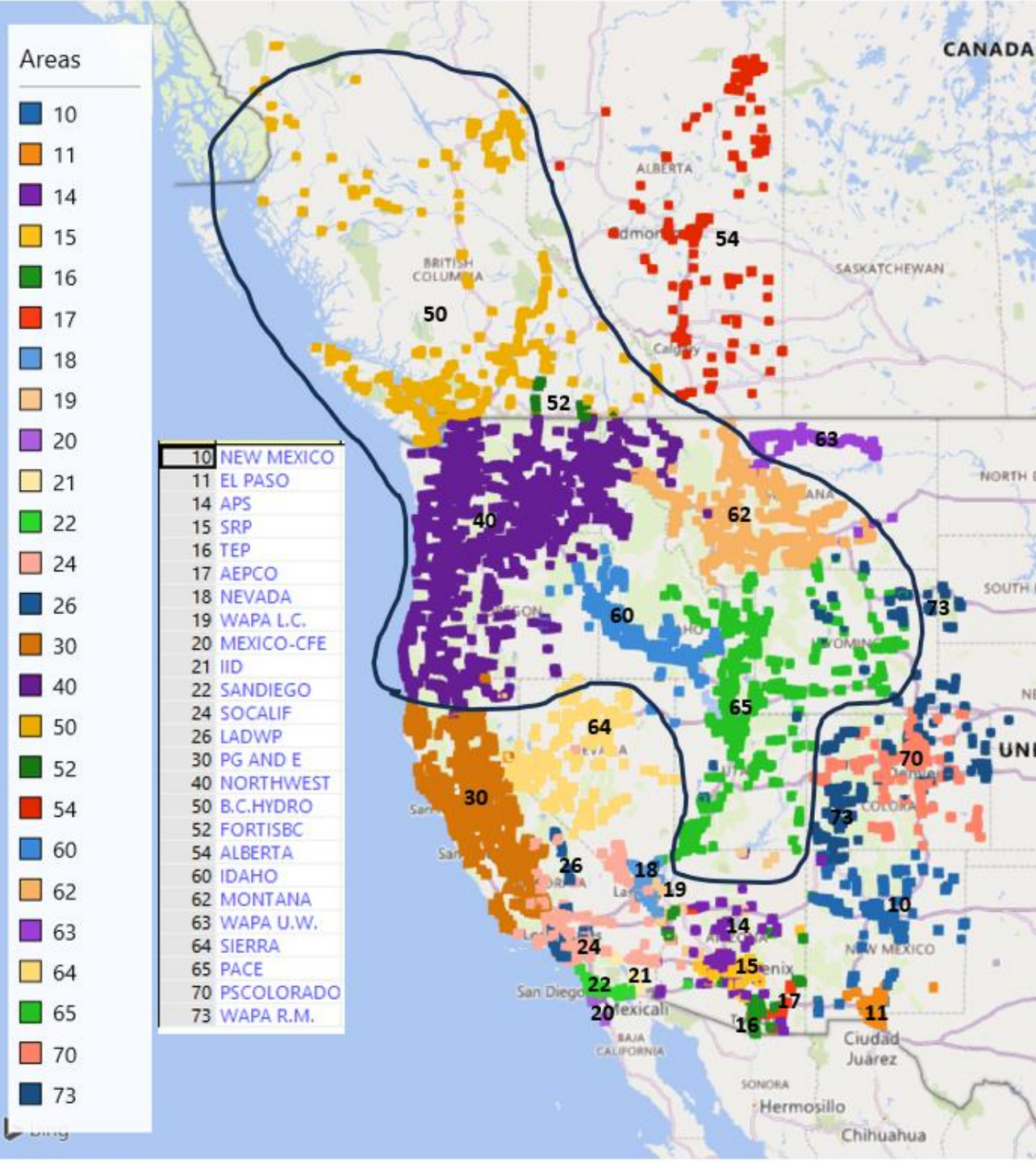
Areas Workaround – “Hole Punching”

» Area “Hole Punching” did not work well with areas which were not contiguous, such as WAPA’s areas.

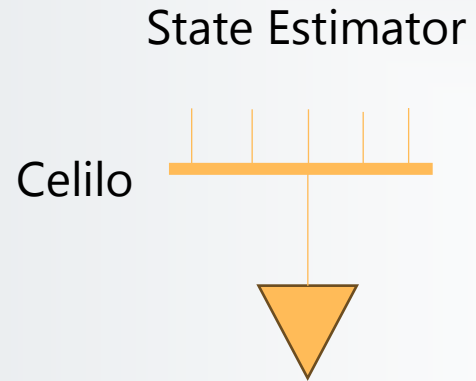
Footprint

» Which areas are
"Contiguous"?

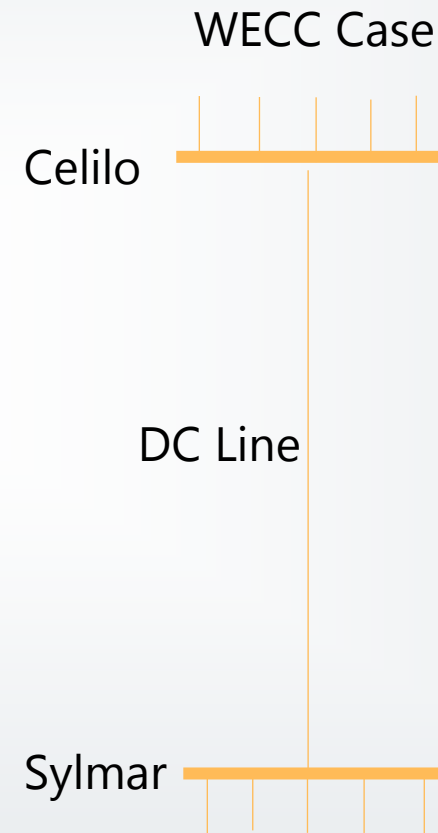
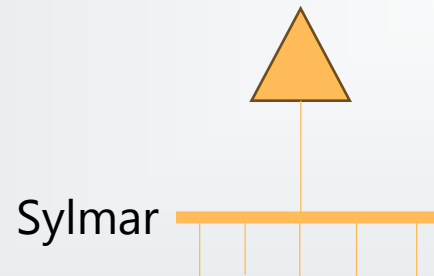
<Pu



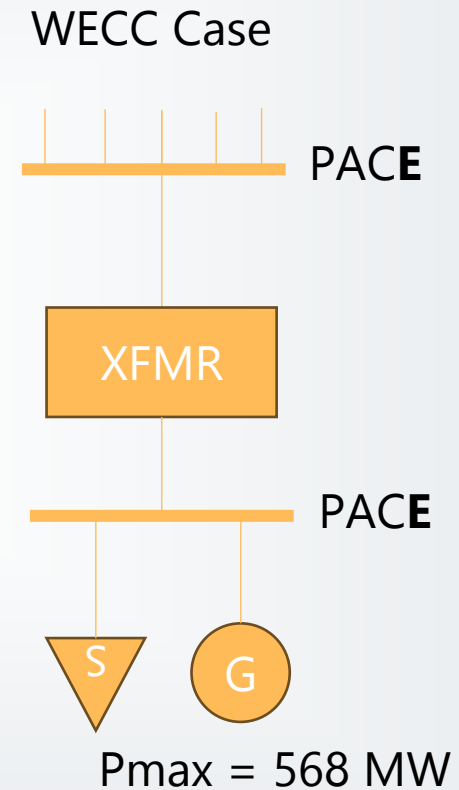
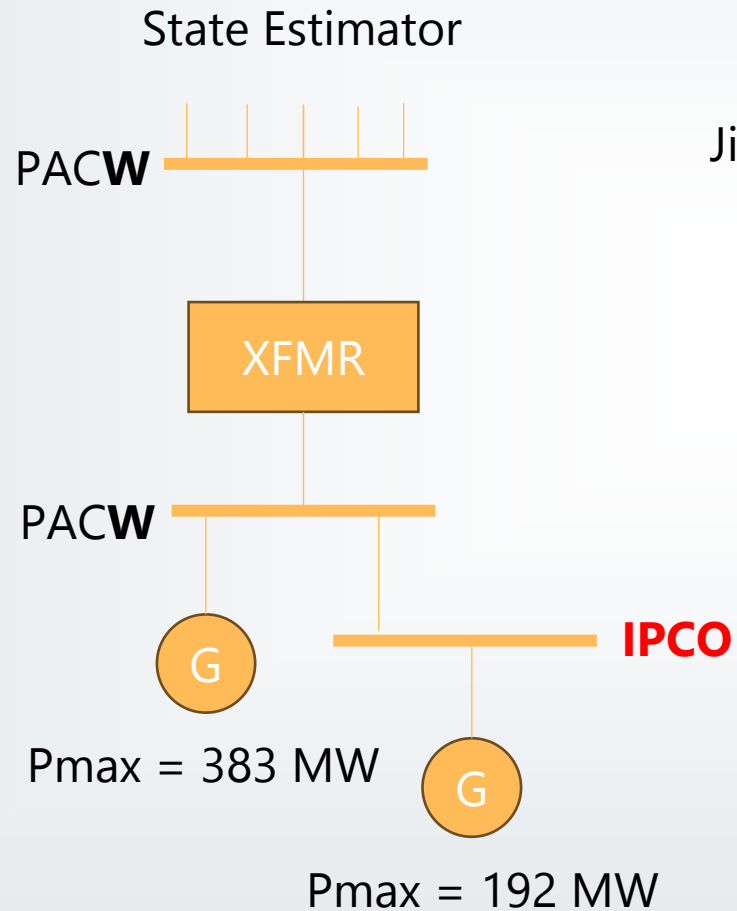
DC Lines



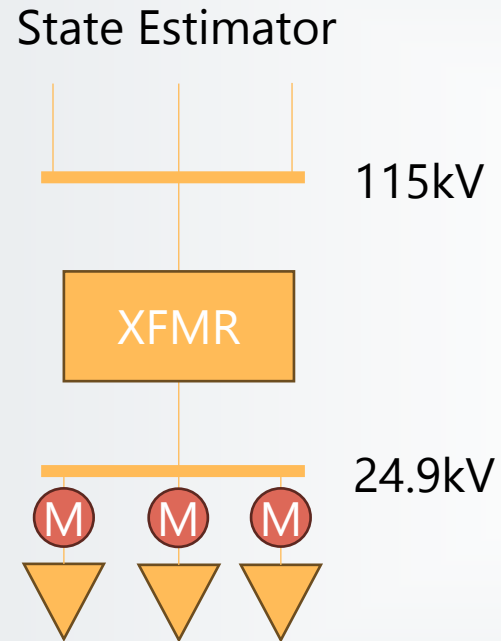
Note: This will impact your area totals.



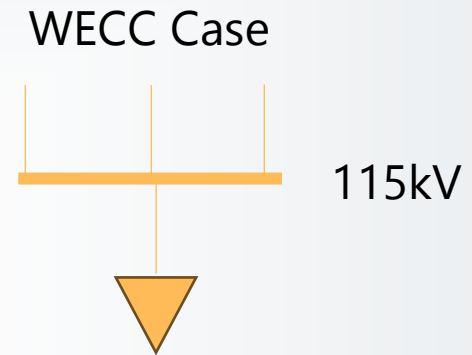
Area/BA Differences



Load (XF)

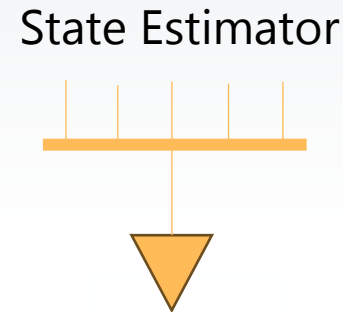
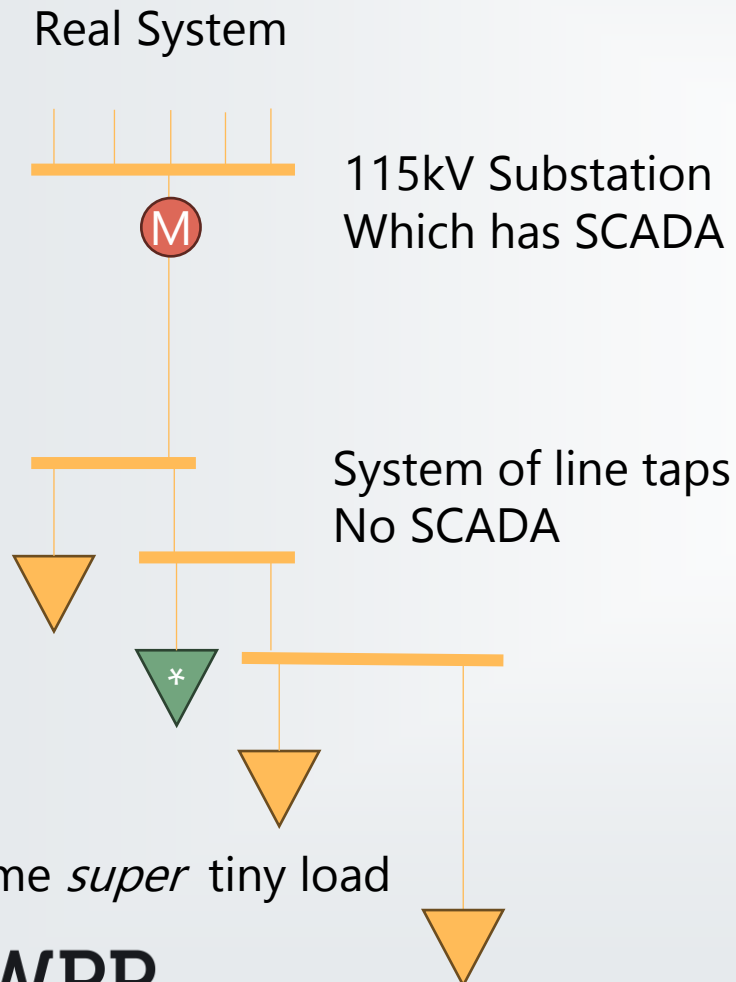


Many : One

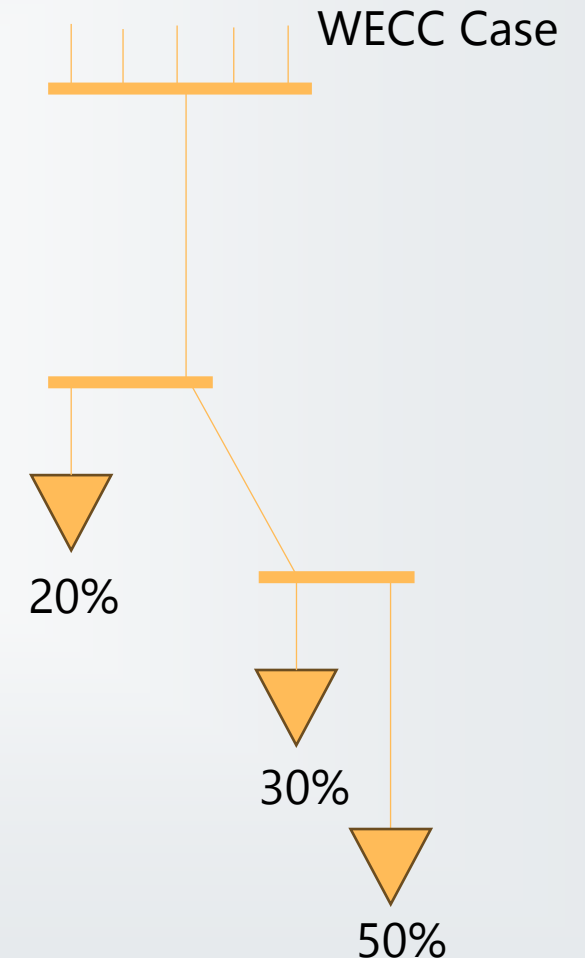


Load (Radial Lines)

Line details needed to plan for line-end voltage.

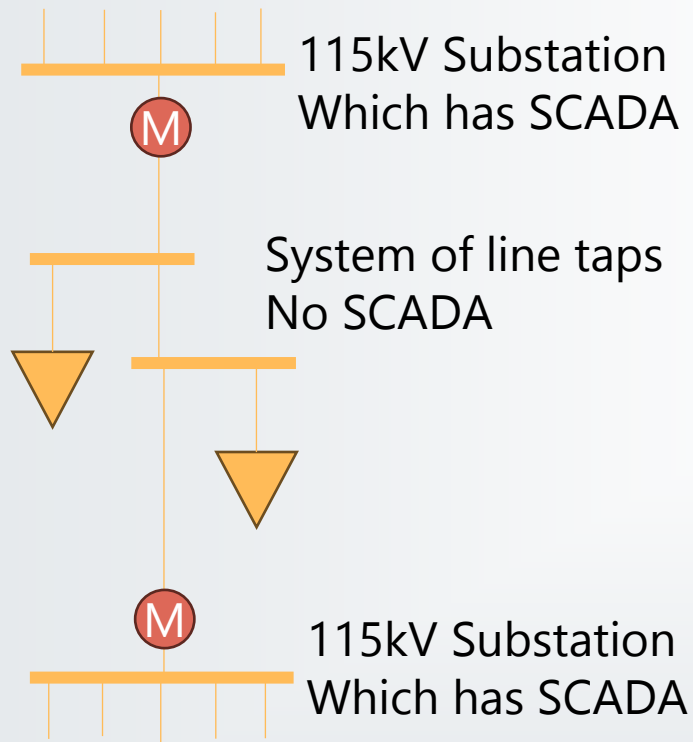


One : Many

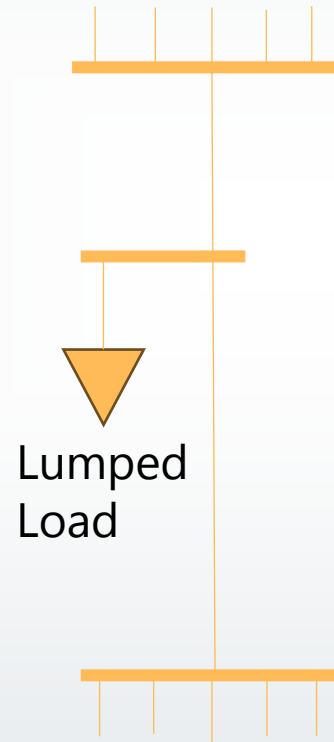


Load (Networked Lines)

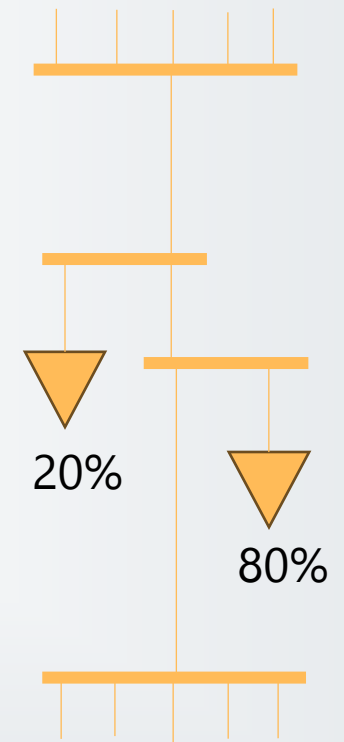
Real System



State Estimator



WECC Case



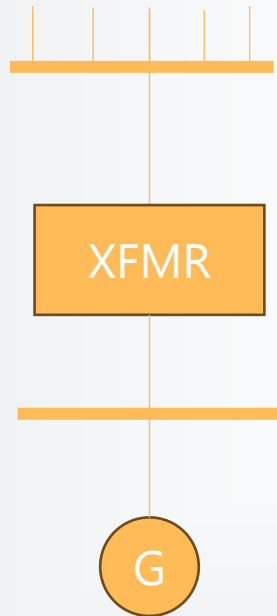
Gen

Station Service

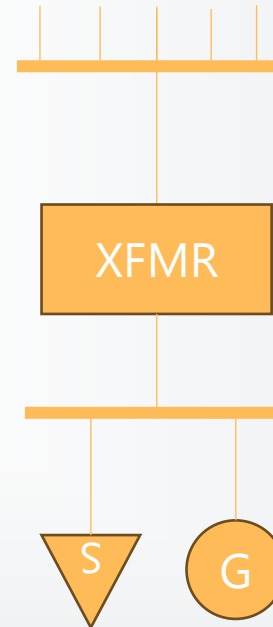
Often modelled in WECC

Not often modelled in RC West

State Estimator



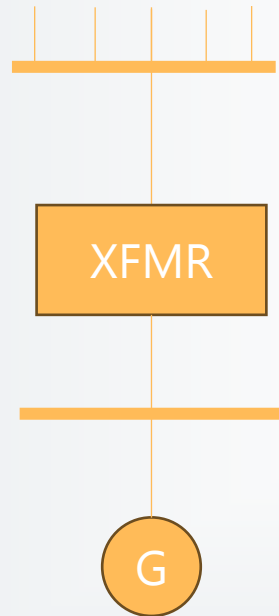
WECC Case



Gen

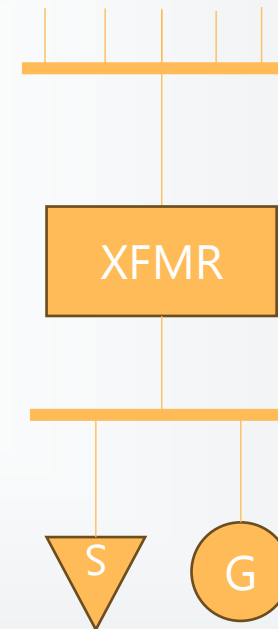
Pawnee

State Estimator



$P_{\text{gen}} = 1040 \text{ MW}$

WECC Case



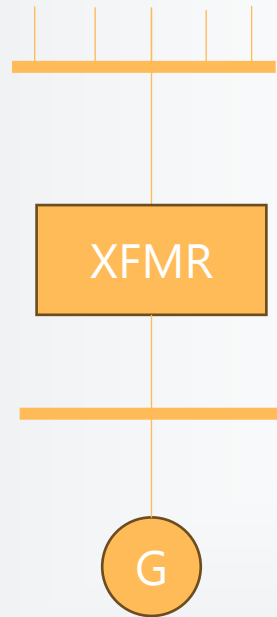
24 MW

$P_{\text{max}} = 536 \text{ MW}$

Gen

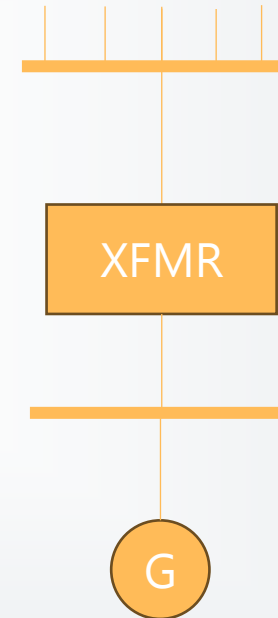
PI not equal to RC West

State Estimator



$P_{gen} = 704 \text{ MW}$

WECC Case – Setup by PI Data

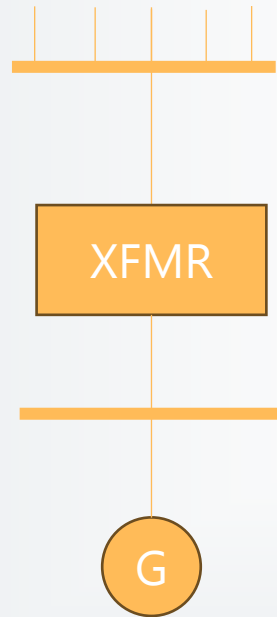


$P_{gen} = 783 \text{ MW}$

DVAR

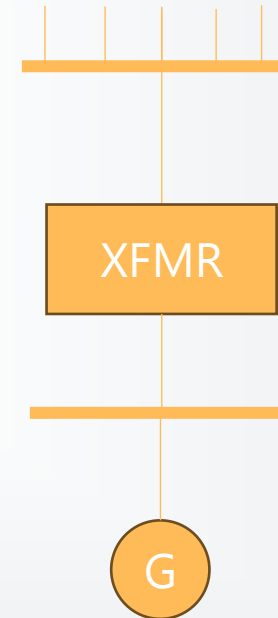
DVARs might be generating or acting as load in RC West
(Boise Bench DVAR is one such example)

State Estimator



$P_{\text{gen}} = 10.3 \text{ MW}$

WECC Case

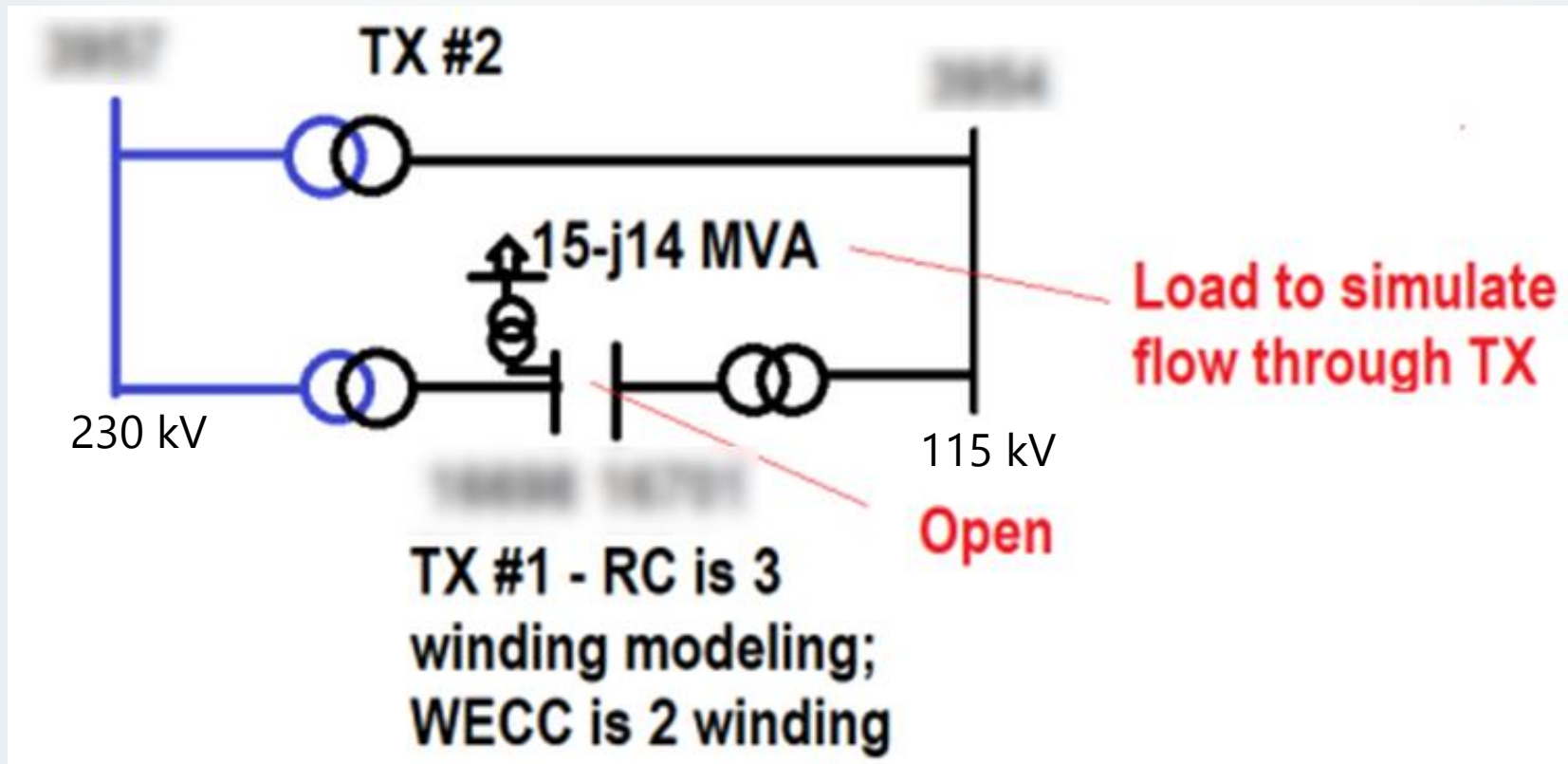


$P_{\text{max}} = 0 \text{ MW}$

Transformers

- » Many transformer R & X values did not match between WECC and RC West.
- » WPP recommends *all areas* go through a process to verify that their XF & Line impedances match between RC West and WECC models.

Transformers



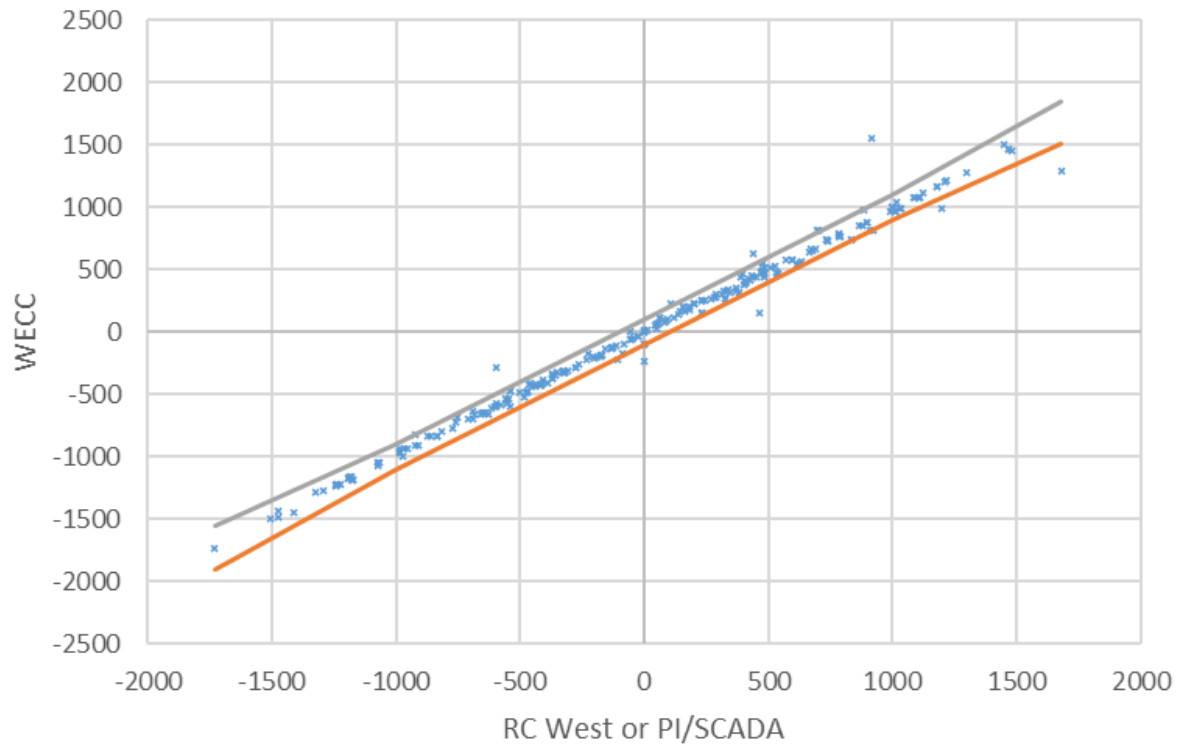
Negative Loads

- » Some negative loads were generators.
- » Many others were not easy to explain.
- » The reason for many of the negative loads is unknown by WPP at this time.

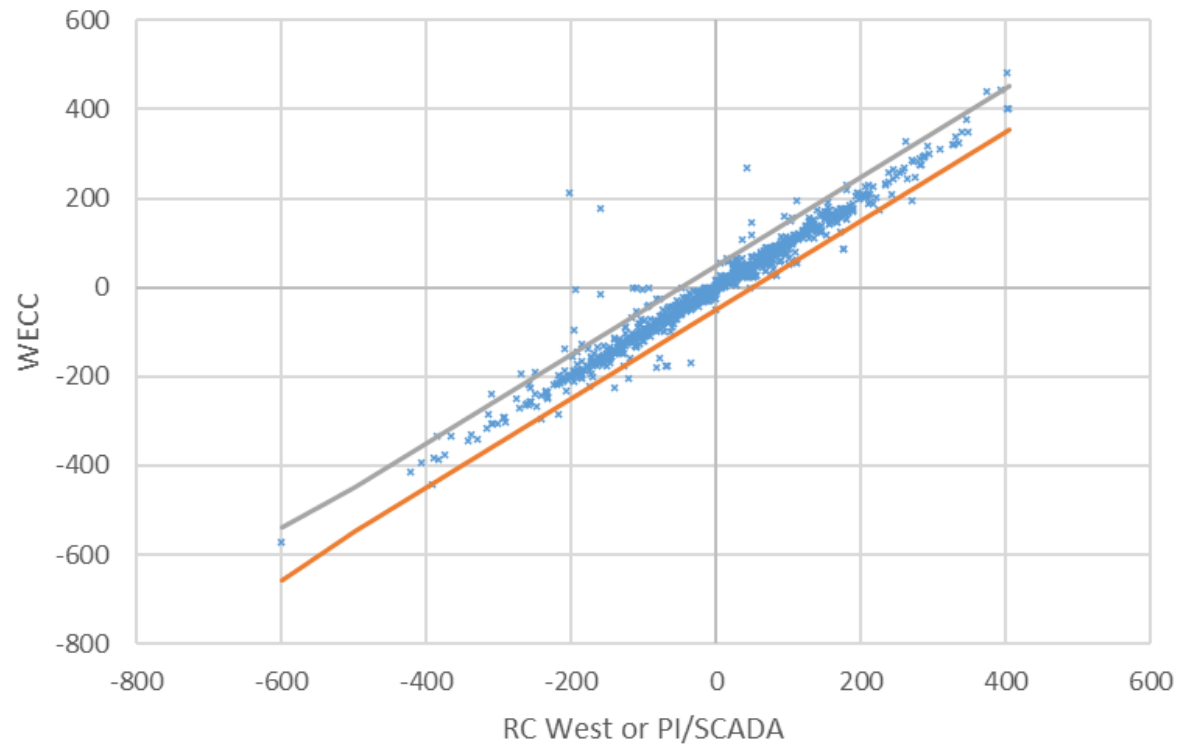
Area Num of Bus	Area Name of Load	Sum of MW
40	NORTHWEST	-1014.25
54	ALBERTA	-691.7
30	PG AND E	-488.86
50	B.C.HYDRO	-425.91
70	PSCOLORADO	-421.97
65	PACE	-343.8
14	APS	-197.75
73	WAPA R.M.	-191.07
18	NEVADA	-165.13
11	EL PASO	-163.83
26	LADWP	-163.09
10	NEW MEXICO	-155.43
64	SIERRA	-138.5
24	SOCALIF	-124.61
19	WAPA L.C.	-62.46
21	IID	-52.35
60	IDAHO	-44.26
62	MONTANA	-43.96
16	TEP	-36.97
20	MEXICO-CFE	-26.54
15	SRP	-23.89
63	WAPA U.W.	-16.36
22	SANDIEGO	-12.45

Steady State Comparison (Pre-Event)

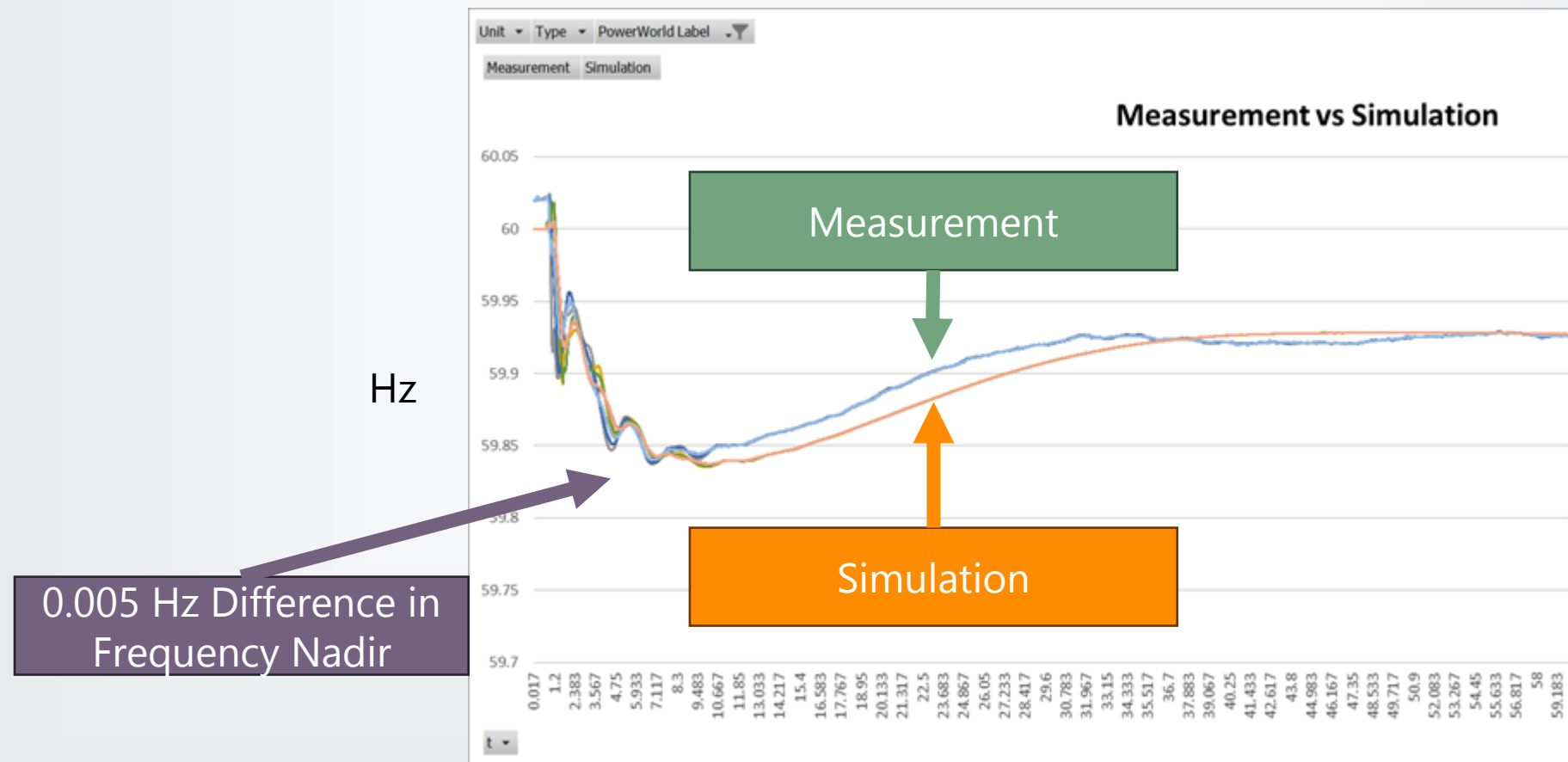
MW Flow Comparisons for 500-600 kV



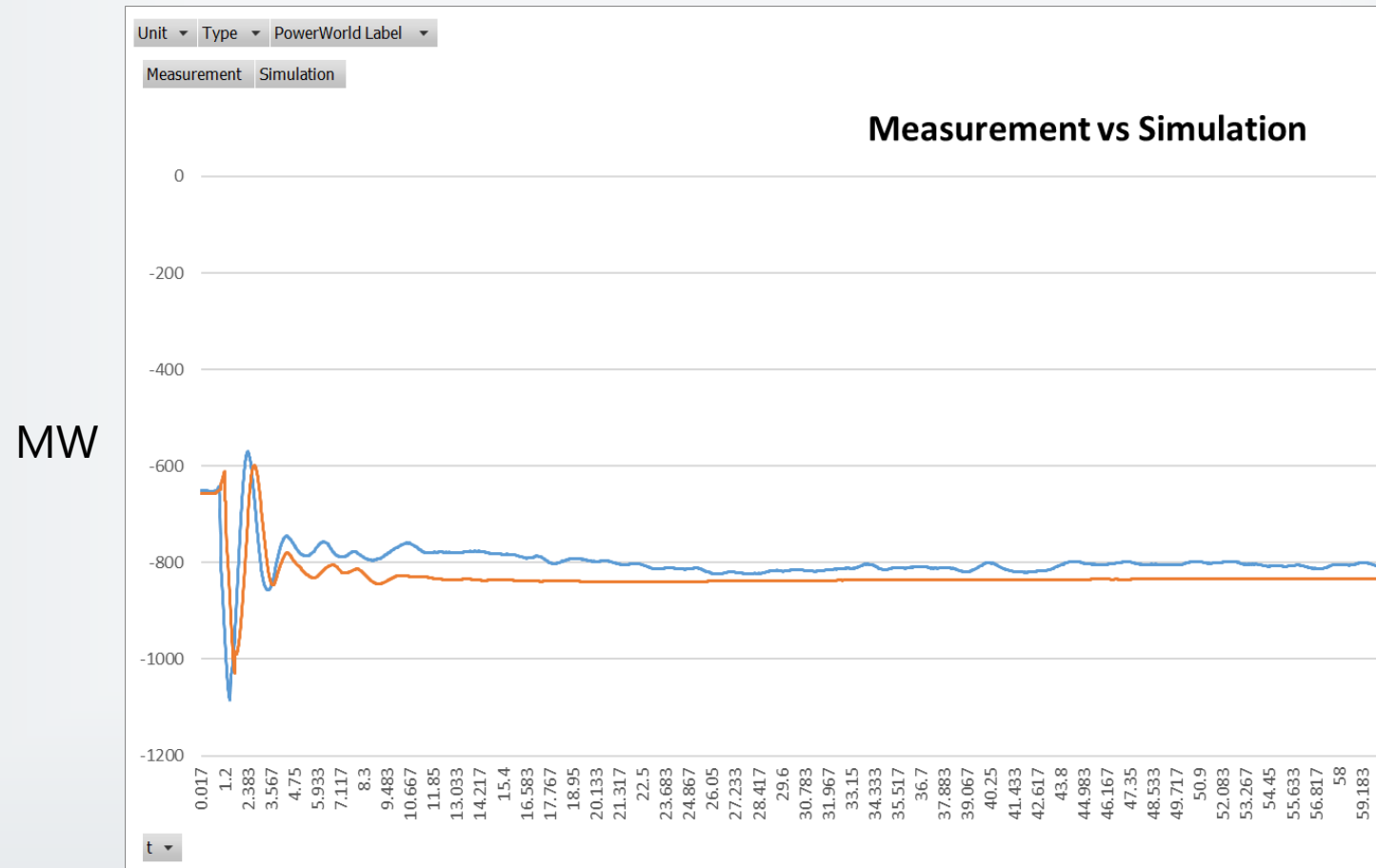
MW Flow Comparisons for 200-300 kV



Dynamics Comparison



Dynamics Comparison



Recommendations

- » RC West should be compared against some Utility PI Data.
- » WECC to RC West Mapping.
 - » A full WECC-Wide mapping effort should be performed.
 - » It should be maintained somewhere central; WECC or RC West.

»Please check your impedances!!!

Questions?

*Image by DALL-E 3

