TPL-007 Screening

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For: WPP Area 40 Team

Annual TPL-007 Data Screening

On 1-2 Ops Cases per Year (at Area 40 member discretion):

- For the base-case:
  - Save the case as [*.PWB, *.EPC, *.RAW] with [*.GIC (PSSE), *.GMD (PSLF)] formats, for all to use.
  - Export the GMD input-data from PowerWorld into XLSX, so members can view the current dataset.
  - Report any suspicious data, or data-errors, via a “SADD”-like script
  - For 8V/km & 12V/km (Informational purposes for members):
    - Report worst-case angle values for transformer GIC
    - Report worst-case angle values for area losses
- Combos of [8V/km and 12V/km] x [0, 30, 60, 90, 120, 150 deg]
  - Save each case with the added GIC transformer VAR losses included in the power flow case as *.PWB, *.EPC, *.RAW
  - Save GIC branch flows to CSV
  - Save VAR loss loads to CSV
  - Save GIC flows in a specific layout for GICHarm usage
- Use the PowerWorld “Auto-Insert Buses” feature to make a map diagram, to make the Lat/Long errors clear as day. Fix as needed, log which ones were manually adjusted by WPP-staff.
- Save out CSV time-series for transformers with GIC > 75A.
- Refresh an Excel summary sheet, that aggregates the results,
- Send results to WECC staff for posting on the base-cases page.

WPP

Main Results

TPL-007 Overview.xlsx -> Max XFMR GIC & Angle

V/km
8
12
16
20
24
28
32

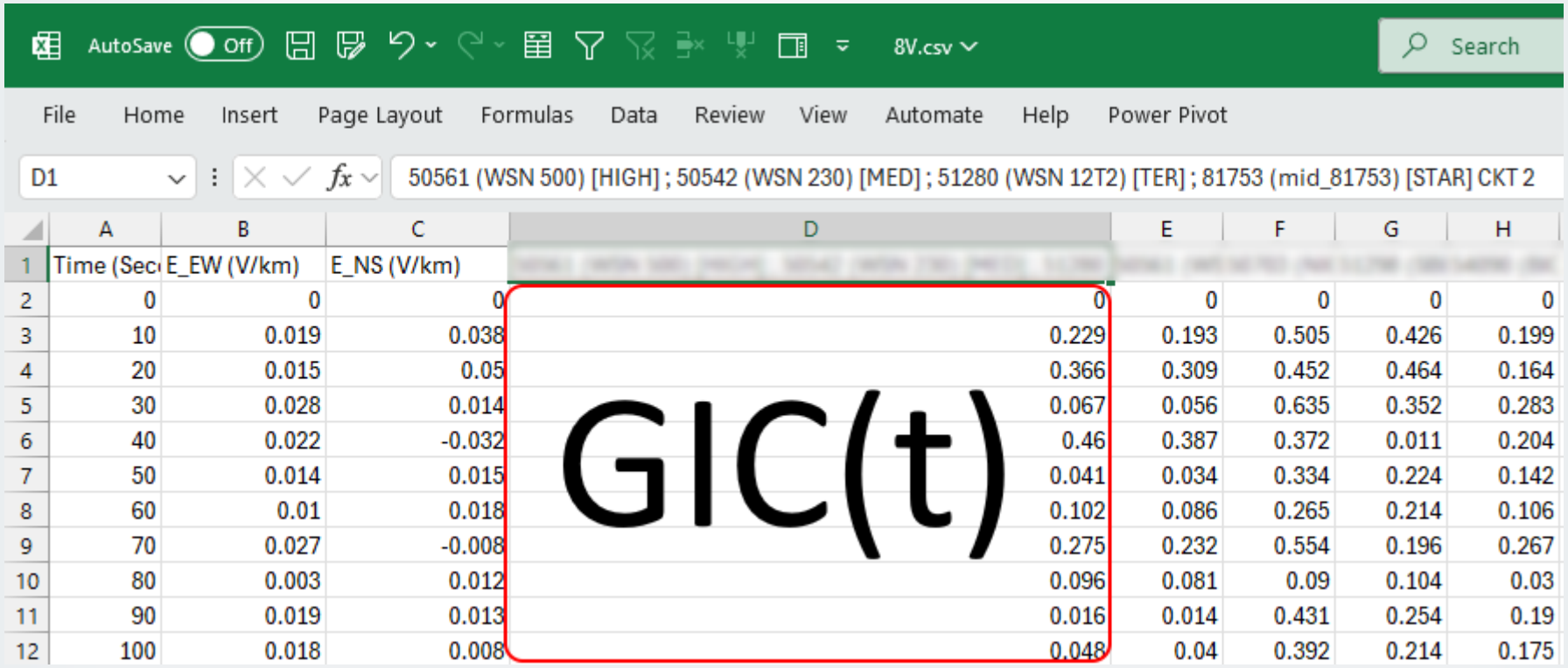
AreaNum
50
54
10
11
14
15
16
17

Level
<75A
>75A
>85A

V/	Bus	BusName	Bu	Bus	BusName	Bu	Bus	BusName	Bu	Lin	A	AreaName	Zor	ZoneName	GICMaxIEffective	GICMaxDegrees	GICMaxQLosses	GICMaxAmpsToNeutral3	GICMaxAmpsToNeutral3Degrees
8										3	50	B.C.HYDRO	500	BC HYDRO	169.7	82.9	196.7	519.8	79.0
8										2	50	B.C.HYDRO	500	BC HYDRO	96.0	143.0	108.5	288.1	143.0
8										21	50	B.C.HYDRO	500	BC HYDRO	89.7	54.2	101.0	332.8	44.2
8										4	50	B.C.HYDRO	500	BC HYDRO	80.9	143.0	91.4	242.7	143.0
8										1T	54	ALBERTA	545	AIES-Fort McMurray	218.9	19.5	239.1	397.4	16.1
8										2T	54	ALBERTA	543	AIES-Valleyview	201.0	89.6	96.7	599.6	89.4
8										1T	54	ALBERTA	543	AIES-Valleyview	192.3	89.6	92.5	573.6	89.4
8										G2	54	ALBERTA	560	AIES-Lake Wabamun Generation	189.3	129.5	86.2	567.8	129.5
8										G3	54	ALBERTA	560	AIES-Lake Wabamun Generation	179.1	53.2	170.9	537.4	53.2
8										T1	54	ALBERTA	553	AIES-Fort Saskatchewan 2000	152.3	45.4	145.1	0.0	0.0
8										T1	54	ALBERTA	557	AIES-Provost	131.9	67.2	62.2	395.7	67.2
8										T1	54	ALBERTA	586	AIES-Calgary	117.4	81.1	135.8	477.0	110.5
8										1T	54	ALBERTA	545	AIES-Fort McMurray	116.0	8.7	53.3	348.1	8.7
8										T2	54	ALBERTA	553	AIES-Fort Saskatchewan 2000	109.8	47.0	48.9	329.5	47.0
8										T1	54	ALBERTA	545	AIES-Fort McMurray	107.3	54.0	50.1	322.0	54.0
8										T2	54	ALBERTA	545	AIES-Fort McMurray	107.3	54.0	50.1	322.0	54.0
8										1T	54	ALBERTA	563	AIES-Sheerness	102.4	36.7	48.3	307.2	36.7
8										T1	54	ALBERTA	553	AIES-Fort Saskatchewan 2000	100.3	47.0	44.6	300.9	47.0
8										T6	54	ALBERTA	560	AIES-Lake Wabamun Generation	100.3	134.9	46.5	300.8	134.9
8										T1	54	ALBERTA	586	AIES-Calgary	98.8	21.1	44.9	296.3	21.1
8										T2	54	ALBERTA	586	AIES-Calgary	98.8	21.1	44.9	296.3	21.1
8										T3	54	ALBERTA	545	AIES-Fort McMurray	98.4	1.7	45.9	295.1	1.7
8										T1	54	ALBERTA	562	AIES-Hanna	97.6	118.2	46.1	292.8	118.2
8										T2	54	ALBERTA	547	AIES-Athabasca/Lac La Biche	96.7	46.8	45.1	290.0	46.8
8										T3	54	ALBERTA	580	AIES-Edmonton	91.5	110.5	41.1	274.4	110.5
8										T2	54	ALBERTA	545	AIES-Fort McMurray	90.0	72.6	42.4	270.1	72.6
8										G2	54	ALBERTA	560	AIES-Lake Wabamun Generation	87.7	53.2	83.7	263.2	53.2
8										T1	54	ALBERTA	550	AIES-Drayton Valley	86.1	122.9	39.7	258.4	122.9
8										PS	54	ALBERTA	575	AIES-Glenwood	84.9	113.3	39.1	254.8	113.3
8										T1	54	ALBERTA	562	AIES-Hanna	83.6	167.3	39.0	250.8	167.3
8										G1	54	ALBERTA	560	AIES-Lake Wabamun Generation	80.1	53.2	76.5	240.4	53.2
8										T1	54	ALBERTA	549	AIES-Hinton/Edson	78.7	88.4	36.1	236.2	88.4
8										T2	54	ALBERTA	549	AIES-Hinton/Edson	78.7	88.4	36.1	236.2	88.4
8										T1	54	ALBERTA	573	AIES-Fort MacLeod	76.6	70.3	35.4	229.9	70.3
8										PS	54	ALBERTA	545	AIES-Fort McMurray	76.1	72.1	36.1	228.2	72.1

Main Results

PW_GICXFormer_t/8V.csv
PW_GICXFormer_t/12V.csv



	A	B	C	D	E	F	G	H
1	Time (Sec	E_EW (V/km)	E_NS (V/km)					
2	0	0	0	0	0	0	0	0
3	10	0.019	0.038	0.229	0.193	0.505	0.426	0.199
4	20	0.015	0.05	0.366	0.309	0.452	0.464	0.164
5	30	0.028	0.014	0.067	0.056	0.635	0.352	0.283
6	40	0.022	-0.032	0.46	0.387	0.372	0.011	0.204
7	50	0.014	0.015	0.041	0.034	0.334	0.224	0.142
8	60	0.01	0.018	0.102	0.086	0.265	0.214	0.106
9	70	0.027	-0.008	0.275	0.232	0.554	0.196	0.267
10	80	0.003	0.012	0.096	0.081	0.09	0.104	0.03
11	90	0.019	0.013	0.016	0.014	0.431	0.254	0.19
12	100	0.018	0.008	0.048	0.04	0.392	0.214	0.175

_GMD Case Quality Check (WPP).py

Tab	What's wrong?	How do you fix it?
Bus - Undefined Sub	Any bus where there is equipment which may be grounded MUST have a defined substation with a defined Rground.	In the bus record, fill out the substation field, then define your Rground for your substation record.
Bus vs Sub - LatLong	The bus Lat/Long location is more than 0.5 miles away from the defined Substation.	Ensure the Bus has the same Lat/Long as its defined Substation.
SubNum not in BusNums	Example: Substation # 1 contains buses [12001, 12002, 12003]. A substation number MUST be found in the list of buses which it contains.	In this example, you could change the Substation number to any of these numbers: 12001, 12002, or 12003
Sub Missing Rground	Substation Rground is missing (null), or equal to zero.	Enter a measured or assumed value for Rground.
XFMR with Length	From/To buses are in different geographic lat/long locations. Threshold: 0.5 miles.	You could either: 1) Ensure From/To buses are in the same substation, or 2) Ensure the From/To have the same Lat/Long.
XFMR Missing Data	The case has "Unknown" for: GICCoreType (three-leg, etc), XFConfiguration (Delta/Wye etc), or GICAutoXF (Yes/No is autotransformer).	Ensure all transformer data is filled out.
Line Length Suspect	Estimated length (miles) based on Lat/Long is very different from Estimated length (miles) based on R/X. Threshold: Absolute length difference > 0.5 miles, and ratio >1.5 or <0.5	Verify your branch R, X, B, and Lat/Long of From/To buses.
Line R Suspect	1) DC Resistance should be lower than AC Resistance. 2) DC Resistance should be within ~20% of AC Resistance.	Double-check your entry of R1 (positive sequence R) and Rdc.
Line Changes NomkV	A line where From/To buses have different nominal kV values. This is a CRITICAL error as you cannot read the GIC model into GICHarm if you do this!	Open the branch, or change NominalkV to match.

00 Seed 25HS4a1.PWB GMD Case Quality Check.xlsx

_GMD Case Quality Check Readme.xlsx

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Example Data Check

BusNumFr	BusNameFrc	NomkVFro	BusNum	BusNameT	NomkVTc	Circui	BranchDeviceType	GICLineDistanceMile
							TransformerWinding	884
							Transformer	527
							Transformer	263
							Transformer	229
							Transformer	221
							Transformer	221
							Transformer	212
							Transformer	212
							Transformer	192
							TransformerWinding	162
							Transformer	158
							TransformerWinding	115
							TransformerWinding	115
							TransformerWinding	115
							TransformerWinding	115
							Transformer	100
							Transformer	98
							Transformer	98
							Transformer	98
							TransformerWinding	72
							TransformerWinding	72
							Transformer	70
							Transformer	70
							Transformer	63
							Transformer	63
							TransformerWinding	37
							Transformer	30

XFMR with Length | XFMR Missing Data | Line Length Susp

Data Scramble

- Note: Around the time the 25HS4 case was built, there was a PSLF bug which re-sorted the values, causing all data for GIC to be scrambled.
- WPP has replaced the 25HS4 GIC data by borrowing it from 25LS4 (which was created after the bug-fix).

Data Modifications to 25HS4 for the Screening

- Line Resistances
  - Rac < Rdc? Not possible. Skin effect. Set Rdc = Rac.
  - Rac > 1.2 x Rdc? Unlikely. Set Rdc = Rac.
- Lat/Long Errors
  - R, X, B => “X” Mile long line
  - Lat/Long => “Y” Mile long line
  - If |X-Y| > 100 Miles… Ben tried to repair, or improve!
- Unused GSUs
  - Get opened (study precedence)
- Substation Rground = 0, or Null
  - Set to 0.1 Ohms (study precedence)
  - Note, this only matters if there is a piece of equipment with a ground-path!

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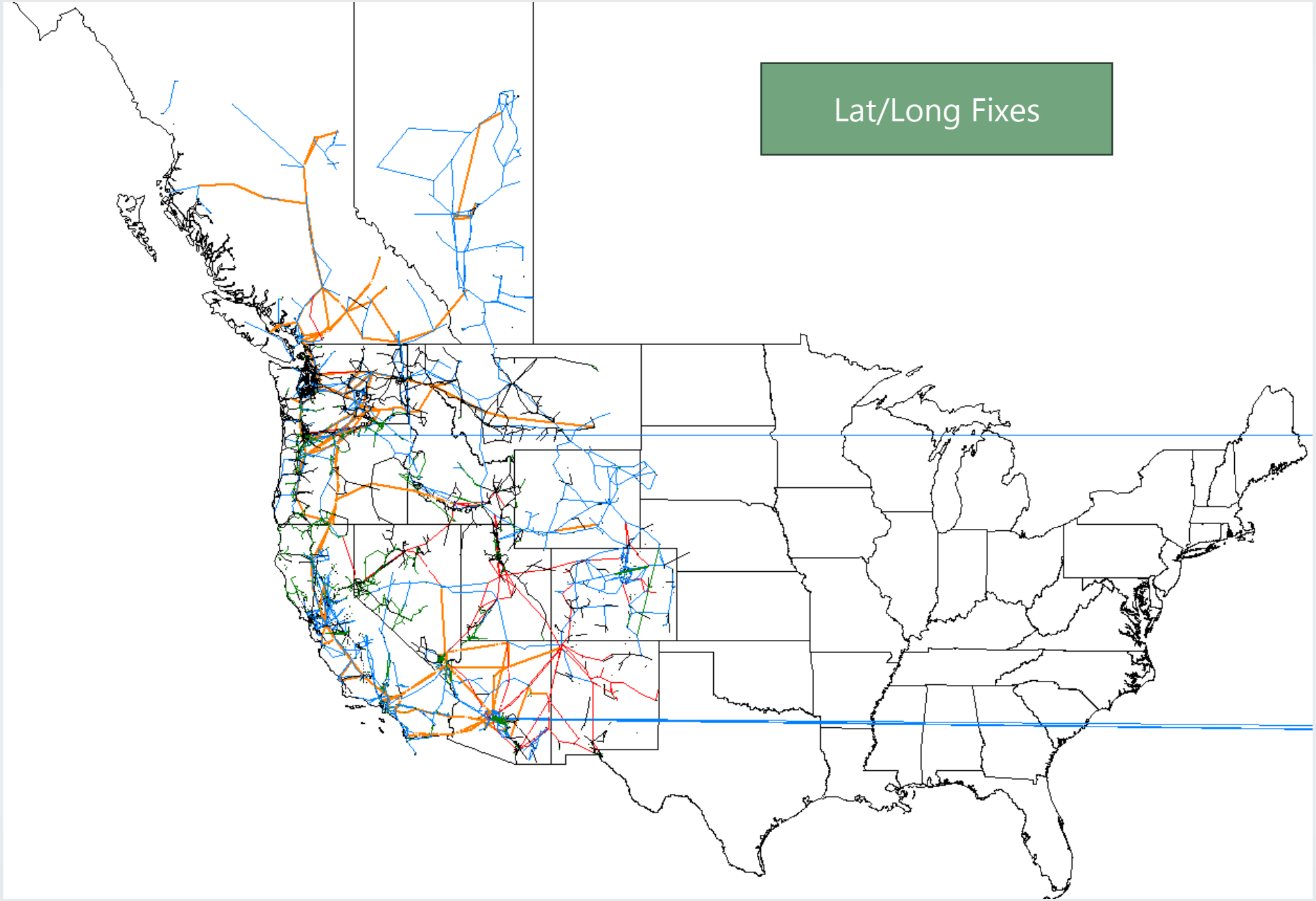
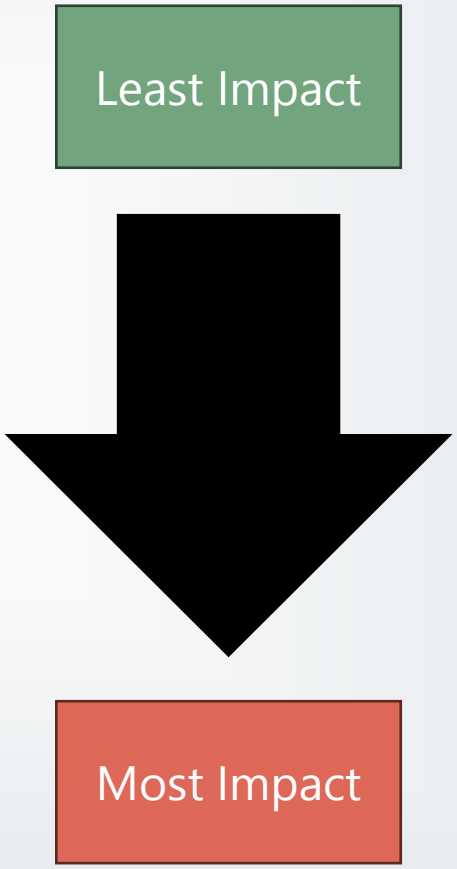

Lat/Long Fixes

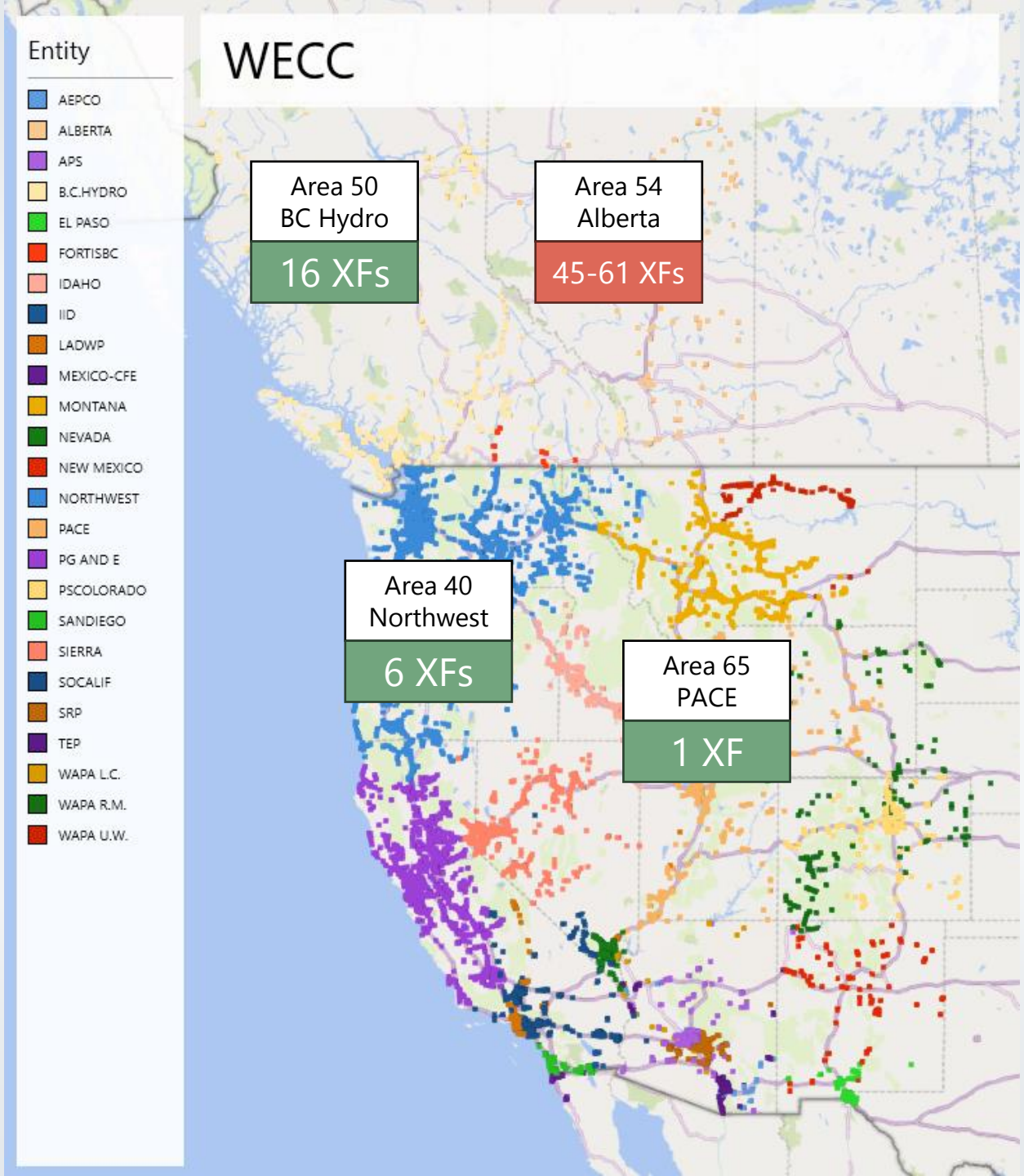
Sensitivity Tests

- Line DC Resistances
- Lat/Long
- Unused GSUs
- Substation Rground



Sensitivity Tests
Transformers > 75A
At 12V / km

Intention
See how modifying assumptions can impact results



Note
Very little difference in 40, 50, 65.

>75A

Max of Case				
Area	WPP_Base_12V	Orig_GSU_Status_12V	Orig_LatLong_12V	Orig_Rdc_12V
65	75.5	75.4	75.5	75.5

>75A

Max of Case					
Area	WPP_Base_12V	Orig_GSU_Status_12V	Orig_LatLong_12V	Orig_Sub_Rground_12V	Orig_Rdc_12V
40	80.1	80.1	80.1	80.8	80.1
40	106.6	106.6	106.6	106.7	106.6
40	111.1	111.1	111.1	111.4	111.1
40	86.2	86.2	86.2	83.9	86.2
40	79.5	79.4	79.5	79.5	79.5
40	82	82	86.7	80.7	82

>75A

Max of Case					
Area	WPP_Base_12V	Orig_GSU_Status_12V	Orig_LatLong_12V	Orig_Sub_Rground_12V	Orig_Rdc_12V
50	84.4	84.4	84.4	84.4	84.4
50	84.4	84.4	84.4	84.4	84.4
50	75.5	75.5	75.5	75.5	75.5
50	101.8	101.8	101.8	101.8	101.8
50	100.4	100.4	100.4	100.4	100.4
50	78.7	78.7	78.7	78.7	78.7
50	86.4	86.4	86.4	86.4	86.4
50	144	144	144	144	144
50	121.3	121.3	121.3	121.3	121.3
50	254.6	254.6	254.6	254.5	254.6
50	98.8	98.8	98.8	98.8	98.8
50	134.5	134.5	134.5	134.5	134.5
50	86.3	86.3	86.3	86.3	86.3
50	76.8	76.8	76.8	76.8	76.8
50	77	77	77	77	77
50	77.2	77.2	77.2	77.2	77.2

WPP

Max of Case Area	WPP_Base_12V	Orig_LatLong_12V	Orig_Rdc_12V	Orig_GSU_Status_12V	Orig_Sub_Rground_12V
54	115	115	115	115	86.2
54	79.6	79.6	79.6	94.5	86.6
54	79.9	79.9	79.9	94.9	87
54	103.3	103.3	103.3	103	91.2
54	103.8	103.8	103.8	103.4	91.6
54	228.4	228.4	228.4	240.5	200.1
54	145	145	145	143.9	131.4
54	105.7	105.7	105.7	105.7	87.4
54	283.9	283.9	283.9	280	161.8
54	150.4	150.4	150.4	161.6	97.3
54	164.7	164.7	164.7	176.9	106.5
54	127.4	127.4	127.4	127.1	92.2
54	176.1	176.1	176.1	176.1	142.1
54	76.6	76.6	76.6	93.5	
54	82.5	82.5	82.5	100.8	
54	137.2	137.2	137.2	162.7	84.4
54	85	85	85	90.7	
54	268.7	268.7	268.7	204.4	198.6
54	120.2	120.2	120.2	91.4	88.8
54	131.6	131.6	131.6	100.1	97.3
54	96.5	96.5	96.5		
54	96.5	96.5	96.5		
54	161	155.6	161	161	116.4
54	161	155.6	161	161	116.4
54	100.2	100.2	100.2	100.2	
54	82.9	82.9	82.9	82.9	
54	84.6	84.6	84.6	84.7	
54	109	109	109	109	125.6
54	110.8	110.8	110.8	110.8	127.7

Max of Case Area	WPP_Base_12V	Orig_LatLong_12V	Orig_Rdc_12V	Orig_GSU_Status_12V	Orig_Sub_Rground_12V
54	109	109	109	109	125.6
54	110.8	110.8	110.8	110.8	127.7
54	101.9	101.9	101.9	102.1	
54	101.9	101.9	101.9	102.1	
54	85.4	85.4	85.4	85.4	89.8
54	86.4	86.4	86.4	86.4	90.8
54	301.5	301.5	301.5	301.4	259.6
54	288.4	288.4	288.4	288.4	248.4
54	147.6	147.6	147.6	147.6	111.2
54	75.7	75.7	75.7	75.7	
54	86	86	86	86.1	82.8
54	84.9	84.9	84.9	85	
54	98.6	98.6	98.6	98.7	78
54	102.7	102.6	102.7	102.4	
54	114.1	114.1	114.1	114.1	115.2
54	85	85	85	85.9	87.2
54	97.3	97.3	97.3	98.4	99.8
54	174	174	174	174	155.7
54	153.6	153.6	153.6	101.4	149.8
54				100.3	
54	328.4	328.6	328.4	332.6	329
54	197.9	197.9	197.9	197.9	133.1
54	125.4	125.4	125.4	125.7	120.8
54	146.4	146.4	146.4	149.6	143.1
54				380.4	
54	92.9	92.9	92.9	92.9	
54	92.9	92.9	92.9	92.9	
54	84	84	84	84	

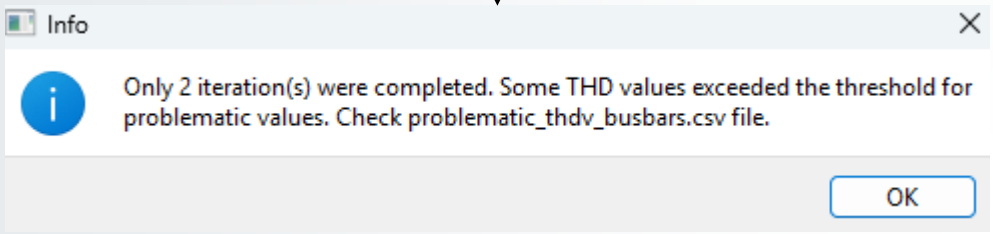
Note
Some big differences in Alberta, Area 54

Next Step…

Harmonic Screening!
(TBD)

Transformer Data Checks

Trying to run a GICHarm screening…



Transformer Table

B: Magnetizing Susceptance
MVA Base: 100 MVA

GSU that acts like a 35 MVAR Capacitor!!!

Is this data-entry-problem causing issues in GICHarm?


Questions?