Introduction

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  - Avista System Planning
    - BSEE, Idaho, 1992
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Transient Stability In PWS

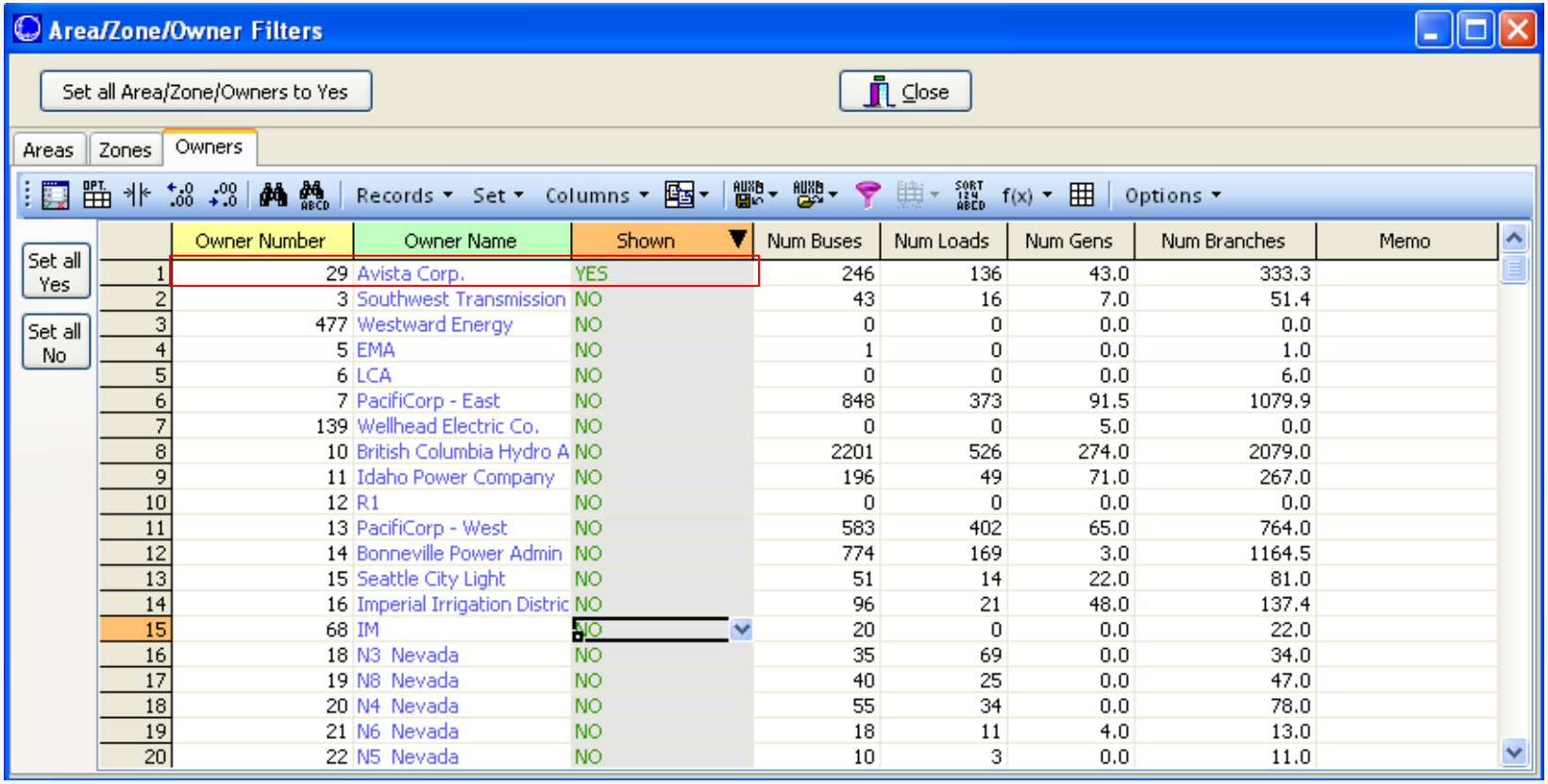
This is a PCC & WECC approved statement

- **YOU ARE FREE TO USE PWS!!!!!!!!!!!**
  - WECC has NO opinion on study software
    - WECC does require *.epc and *.dyd submissions
      - For now…the BCCS alters this
- Things you should know about PWS TS
  - How to “auto insert” stability elements
    - From Power flow ctg tool
      - Excel and Custom String Expressions
  - How to compare results
    - PlayIn
      - Recently modified to accept unmodified GE PSDS output

Adding TS Events From PF CTG

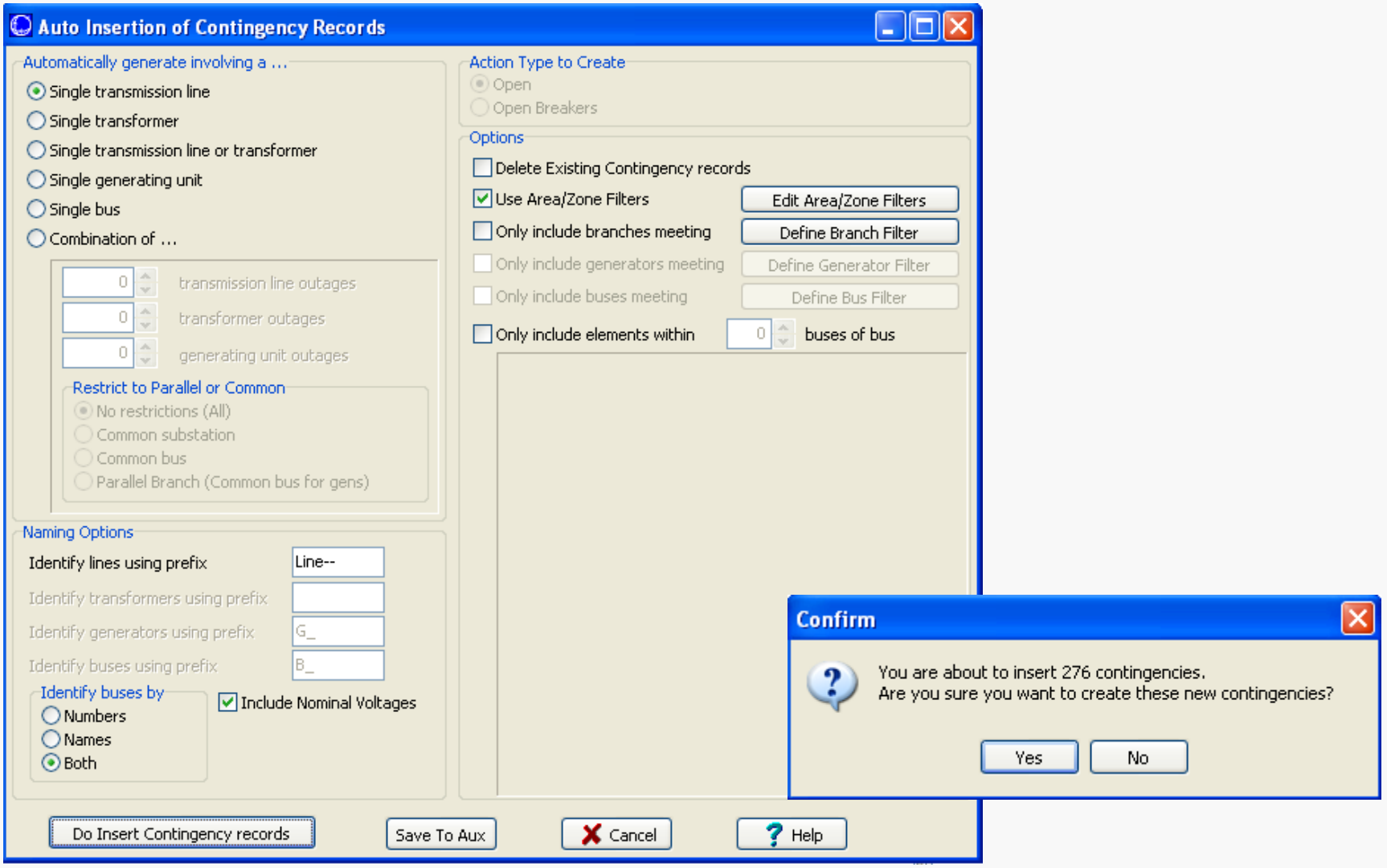
- Auto-Insert in ctg analysis
  - N-1 Lines (Not Branches)
  - Bus Outages (think FERC 754)
- Cut and Paste two to three times
  - Two paste for bus outages
  - Three paste for line outages

Set up Owner Filter

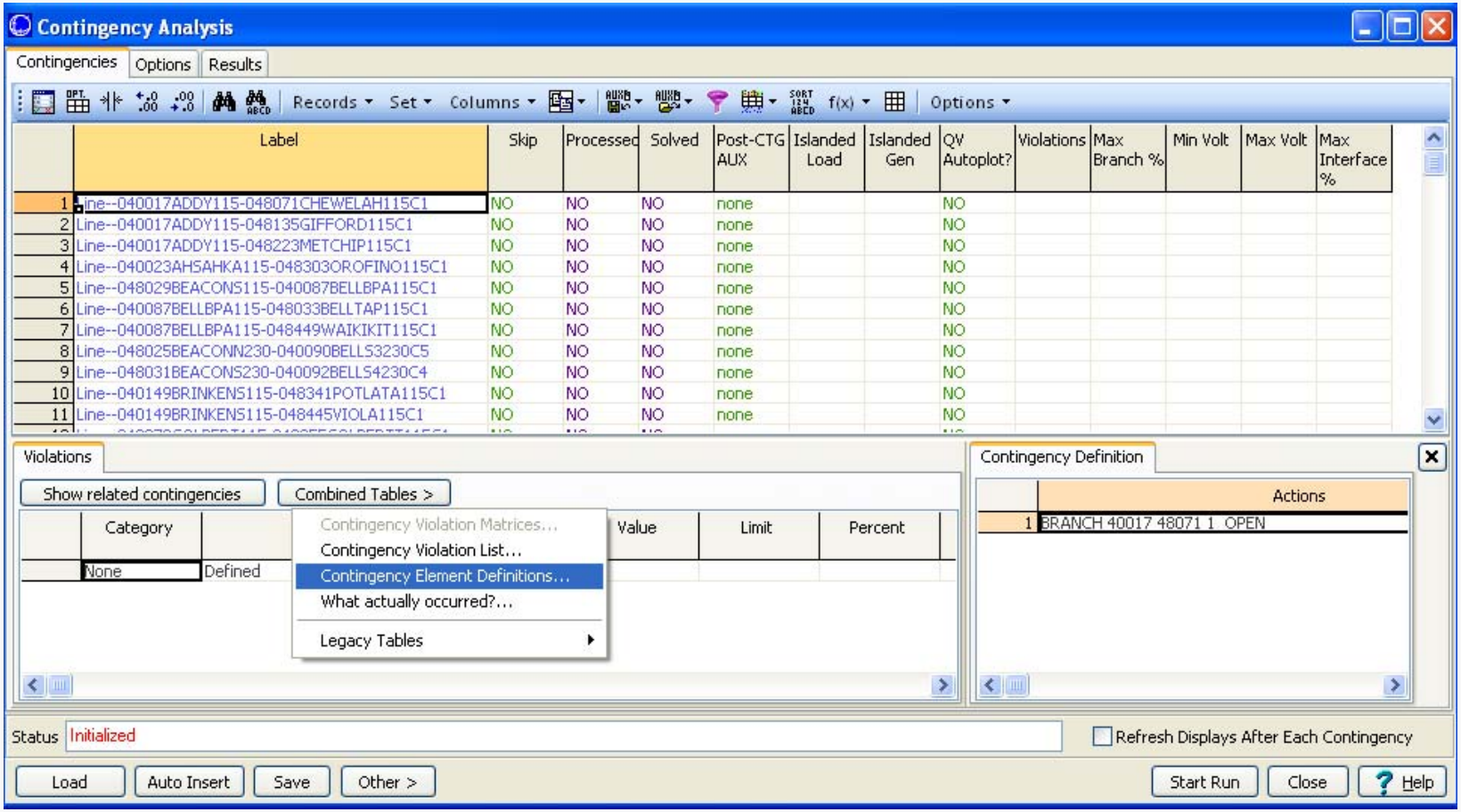


	Owner Number	Owner Name	Shown	Num Buses	Num Loads	Num Gens	Num Branches	Memo
1	29	Avista Corp.	YES	246	136	43.0	333.3	
2	3	Southwest Transmission	NO	43	16	7.0	51.4	
3	477	Westward Energy	NO	0	0	0.0	0.0	
4	5	EMA	NO	1	0	0.0	1.0	
5	6	LCA	NO	0	0	0.0	6.0	
6	7	PacifiCorp - East	NO	848	373	91.5	1079.9	
7	139	Wellhead Electric Co.	NO	0	0	5.0	0.0	
8	10	British Columbia Hydro A	NO	2201	526	274.0	2079.0	
9	11	Idaho Power Company	NO	196	49	71.0	267.0	
10	12	R1	NO	0	0	0.0	0.0	
11	13	PacifiCorp - West	NO	583	402	65.0	764.0	
12	14	Bonneville Power Admin	NO	774	169	3.0	1164.5	
13	15	Seattle City Light	NO	51	14	22.0	81.0	
14	16	Imperial Irrigation Distric	NO	96	21	48.0	137.4	
15	68	IM	NO	20	0	0.0	22.0	
16	18	N3 Nevada	NO	35	69	0.0	34.0	
17	19	N8 Nevada	NO	40	25	0.0	47.0	
18	20	N4 Nevada	NO	55	34	0.0	78.0	
19	21	N6 Nevada	NO	18	11	4.0	13.0	
20	22	N5 Nevada	NO	10	3	0.0	11.0	

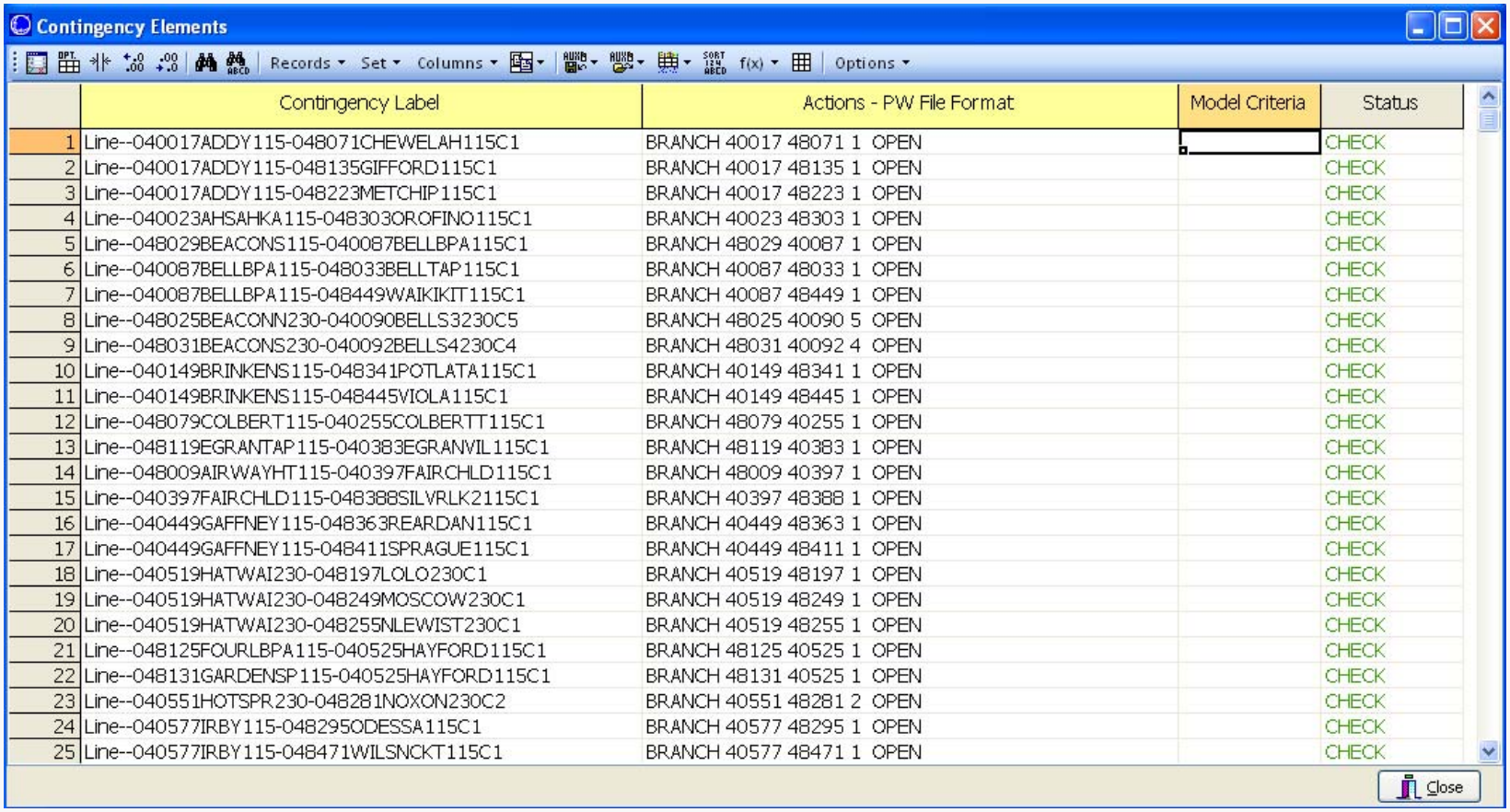
Auto Insert Lines by Owner



Switch to Element View



Contingency Element View



	Contingency Label	Actions - PW File Format	Model Criteria	Status
1	Line--040017ADDY115-048071CHEWELAH115C1	BRANCH 40017 48071 1 OPEN		CHECK
2	Line--040017ADDY115-048135GIFFORD115C1	BRANCH 40017 48135 1 OPEN		CHECK
3	Line--040017ADDY115-048223METCHIP115C1	BRANCH 40017 48223 1 OPEN		CHECK
4	Line--040023AHSAHKA115-048303OROFINO115C1	BRANCH 40023 48303 1 OPEN		CHECK
5	Line--048029BEACONS115-040087BELLBPA115C1	BRANCH 48029 40087 1 OPEN		CHECK
6	Line--040087BELLBPA115-048033BELLTAP115C1	BRANCH 40087 48033 1 OPEN		CHECK
7	Line--040087BELLBPA115-048449WAIKIKIT115C1	BRANCH 40087 48449 1 OPEN		CHECK
8	Line--048025BEACONN230-040090BELLS3230C5	BRANCH 48025 40090 5 OPEN		CHECK
9	Line--048031BEACONS230-040092BELLS4230C4	BRANCH 48031 40092 4 OPEN		CHECK
10	Line--040149BRINKENS115-048341POTLATA115C1	BRANCH 40149 48341 1 OPEN		CHECK
11	Line--040149BRINKENS115-048445VIOLA115C1	BRANCH 40149 48445 1 OPEN		CHECK
12	Line--048079COLBERT115-040255COLBERTT115C1	BRANCH 48079 40255 1 OPEN		CHECK
13	Line--048119EGRANTAP115-040383EGRANVIL115C1	BRANCH 48119 40383 1 OPEN		CHECK
14	Line--048009AIRWAYHT115-040397FAIRCHLD115C1	BRANCH 48009 40397 1 OPEN		CHECK
15	Line--040397FAIRCHLD115-048388SILVRLK2115C1	BRANCH 40397 48388 1 OPEN		CHECK
16	Line--040449GAFFNEY115-048363REARDAN115C1	BRANCH 40449 48363 1 OPEN		CHECK
17	Line--040449GAFFNEY115-048411SPRAGUE115C1	BRANCH 40449 48411 1 OPEN		CHECK
18	Line--040519HATWAI230-048197LOLO230C1	BRANCH 40519 48197 1 OPEN		CHECK
19	Line--040519HATWAI230-048249MOSCOW230C1	BRANCH 40519 48249 1 OPEN		CHECK
20	Line--040519HATWAI230-048255NLEWIST230C1	BRANCH 40519 48255 1 OPEN		CHECK
21	Line--048125FOURLBPA115-040525HAYFORD115C1	BRANCH 48125 40525 1 OPEN		CHECK
22	Line--048131GARDENSP115-040525HAYFORD115C1	BRANCH 48131 40525 1 OPEN		CHECK
23	Line--040551HOTSPR230-048281NOXON230C2	BRANCH 40551 48281 2 OPEN		CHECK
24	Line--040577IRBY115-048295ODESSA115C1	BRANCH 40577 48295 1 OPEN		CHECK
25	Line--040577IRBY115-048471WILSNCKT115C1	BRANCH 40577 48471 1 OPEN		CHECK

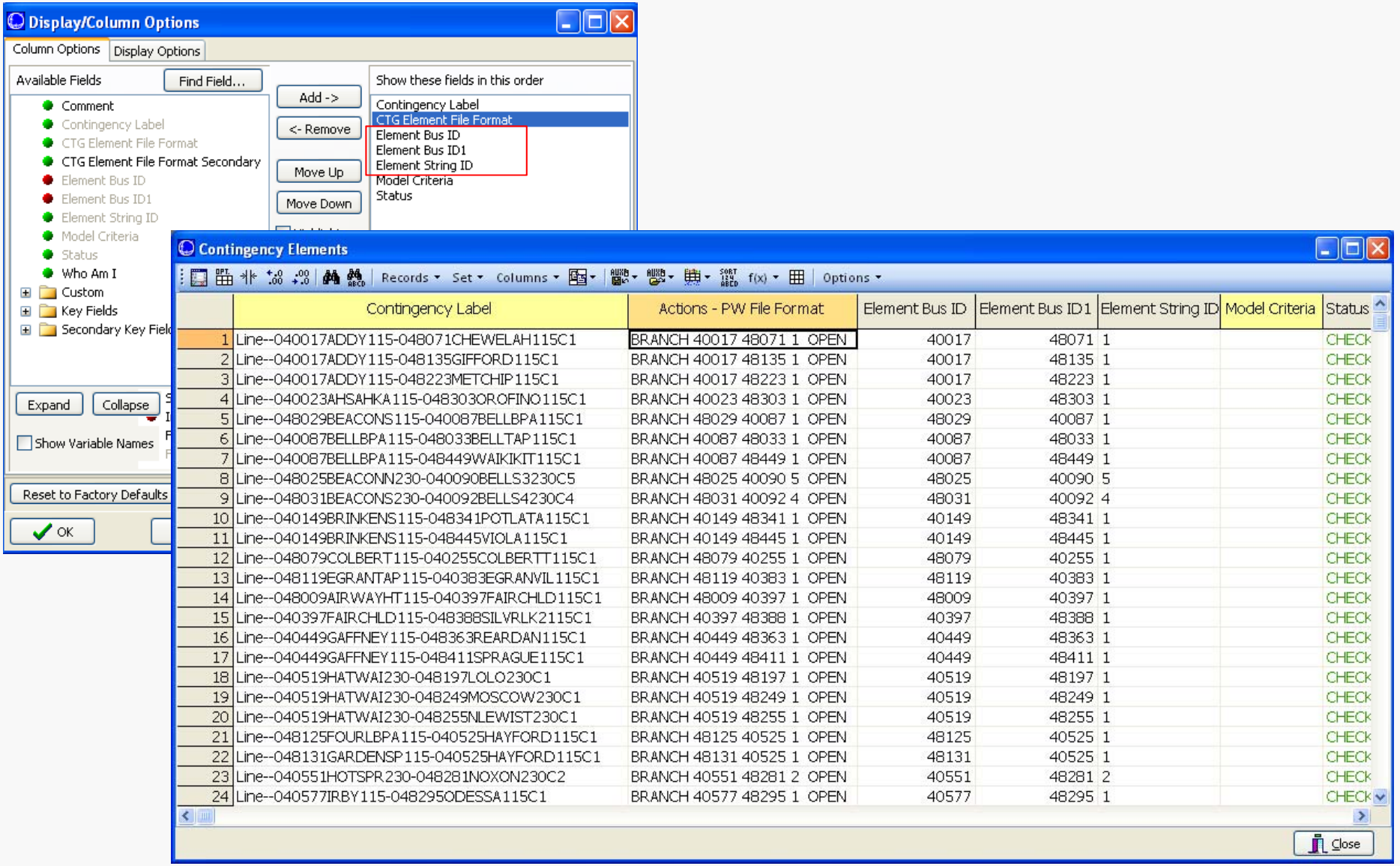
Where we want to land

- We will need to make the power flow ctg descriptions fit the transient stability form.
  - -Use the display/column right click, add columns
  - -Use the Custom String Expression to concatenate to the TS form
  - -Cut and paste three times or so

Transient Stability Events

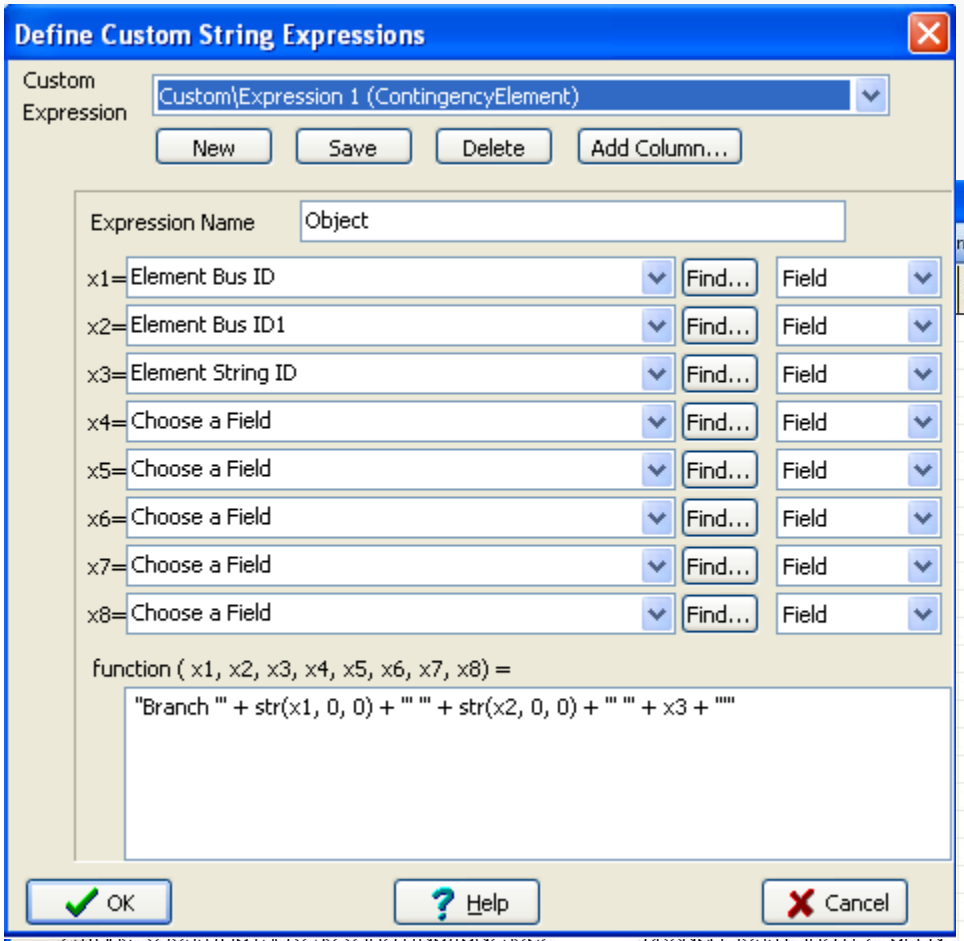
Object Pretty	Time (Seconds)	Object	Description	Enabled	Model Criteria	Contingency Name
Line BOULDER TO RATHDRUM CKT 1	1	Branch '48524' '48357' '1'	FAULT 10 3PB SOLID	CHECK		My Transient Contingency
Line BOULDER TO RATHDRUM CKT 1	1.083	Branch '48524' '48357' '1'	OPEN NEAR	CHECK		My Transient Contingency
Line BOULDER TO RATHDRUM CKT 1	1.083	Branch '48524' '48357' '1'	OPEN FAR	CHECK		My Transient Contingency

Columns to Add



	Contingency Label	Actions - PW File Format	Element Bus ID	Element Bus ID1	Element String ID	Model Criteria	Status
1	Line--040017ADDY115-048071CHEWELAH115C1	BRANCH 40017 48071 1 OPEN	40017	48071	1		CHECK
2	Line--040017ADDY115-048135GIFFORD115C1	BRANCH 40017 48135 1 OPEN	40017	48135	1		CHECK
3	Line--040017ADDY115-048223METCHIP115C1	BRANCH 40017 48223 1 OPEN	40017	48223	1		CHECK
4	Line--040023AHSAHKA115-048303OROFINO115C1	BRANCH 40023 48303 1 OPEN	40023	48303	1		CHECK
5	Line--048029BEACONS115-040087BELLBPA115C1	BRANCH 48029 40087 1 OPEN	48029	40087	1		CHECK
6	Line--040087BELLBPA115-048033BELLTAP115C1	BRANCH 40087 48033 1 OPEN	40087	48033	1		CHECK
7	Line--040087BELLBPA115-048449WAIKIKIT115C1	BRANCH 40087 48449 1 OPEN	40087	48449	1		CHECK
8	Line--048025BEACONN230-040090BELLS3230C5	BRANCH 48025 40090 5 OPEN	48025	40090	5		CHECK
9	Line--048031BEACONS230-040092BELLS4230C4	BRANCH 48031 40092 4 OPEN	48031	40092	4		CHECK
10	Line--040149BRINKENS115-048341POTLATA115C1	BRANCH 40149 48341 1 OPEN	40149	48341	1		CHECK
11	Line--040149BRINKENS115-048445VIOLA115C1	BRANCH 40149 48445 1 OPEN	40149	48445	1		CHECK
12	Line--048079COLBERT115-040255COLBERTT115C1	BRANCH 48079 40255 1 OPEN	48079	40255	1		CHECK
13	Line--048119EGRANTAP115-040383EGRANVIL115C1	BRANCH 48119 40383 1 OPEN	48119	40383	1		CHECK
14	Line--048009AIRWAYHT115-040397FAIRCHLD115C1	BRANCH 48009 40397 1 OPEN	48009	40397	1		CHECK
15	Line--040397FAIRCHLD115-048388SILVRLK2115C1	BRANCH 40397 48388 1 OPEN	40397	48388	1		CHECK
16	Line--040449GAFFNEY115-048363REARDAN115C1	BRANCH 40449 48363 1 OPEN	40449	48363	1		CHECK
17	Line--040449GAFFNEY115-048411SPRAGUE115C1	BRANCH 40449 48411 1 OPEN	40449	48411	1		CHECK
18	Line--040519HATWAI230-048197LOLO230C1	BRANCH 40519 48197 1 OPEN	40519	48197	1		CHECK
19	Line--040519HATWAI230-048249MOSCOW230C1	BRANCH 40519 48249 1 OPEN	40519	48249	1		CHECK
20	Line--040519HATWAI230-048255NLEWIST230C1	BRANCH 40519 48255 1 OPEN	40519	48255	1		CHECK
21	Line--048125FOURLBPA115-040525HAYFORD115C1	BRANCH 48125 40525 1 OPEN	48125	40525	1		CHECK
22	Line--048131GARDENSP115-040525HAYFORD115C1	BRANCH 48131 40525 1 OPEN	48131	40525	1		CHECK
23	Line--040551HOTSPR230-048281NOXON230C2	BRANCH 40551 48281 2 OPEN	40551	48281	2		CHECK
24	Line--040577IRBY115-048295ODESSA115C1	BRANCH 40577 48295 1 OPEN	40577	48295	1		CHECK

Custom String Expression



Remember, we want the form of:
Branch '48524' '48357' '1'

Element Bus ID	Element Bus ID1	Element String ID	Object-CSE
40017	48071	1	Branch '40017' '48071' '1'
40017	48135	1	Branch '40017' '48135' '1'
40017	48223	1	Branch '40017' '48223' '1'
40023	48303	1	Branch '40023' '48303' '1'
48029	40087	1	Branch '48029' '40087' '1'
40087	48033	1	Branch '40087' '48033' '1'
40087	48449	1	Branch '40087' '48449' '1'
48025	40090	5	Branch '48025' '40090' '5'
48031	40092	4	Branch '48031' '40092' '4'
40149	48341	1	Branch '40149' '48341' '1'
40149	48445	1	Branch '40149' '48445' '1'
48079	40255	1	Branch '48079' '40255' '1'
48119	40383	1	Branch '48119' '40383' '1'
48009	40397	1	Branch '48009' '40397' '1'
40397	48388	1	Branch '40397' '48388' '1'
40449	48363	1	Branch '40449' '48363' '1'
40449	48411	1	Branch '40449' '48411' '1'
40519	48197	1	Branch '40519' '48197' '1'
40519	48249	1	Branch '40519' '48249' '1'
40519	48255	1	Branch '40519' '48255' '1'
48125	40525	1	Branch '48125' '40525' '1'
48131	40525	1	Branch '48131' '40525' '1'
40551	48281	2	Branch '40551' '48281' '2'
40577	48295	1	Branch '40577' '48295' '1'
40577	48471	1	Branch '40577' '48471' '1'
40607	48175	1	Branch '40607' '48175' '1'

Close

24	Line--040577IRBY115-048295ODESSA115C1	BRANCH 40577 48295 1	OPEN	
25	Line--040577IRBY115-048471WILSNCKT115C1	BRANCH 40577 48471 1	OPEN	
26	Line--040607KETTLET115-048175KETTLEAV115C1	BRANCH 40607 48175 1	OPEN	

The Custom String Expression

"Branch '" + str(x1, 0, 0) + "' '" + str(x2, 0, 0)
+ "' '" + x3 + "'"

The above gives us:

Branch '48524' '48357' '1'

Yay! Now we can talk Transient Stability lingo

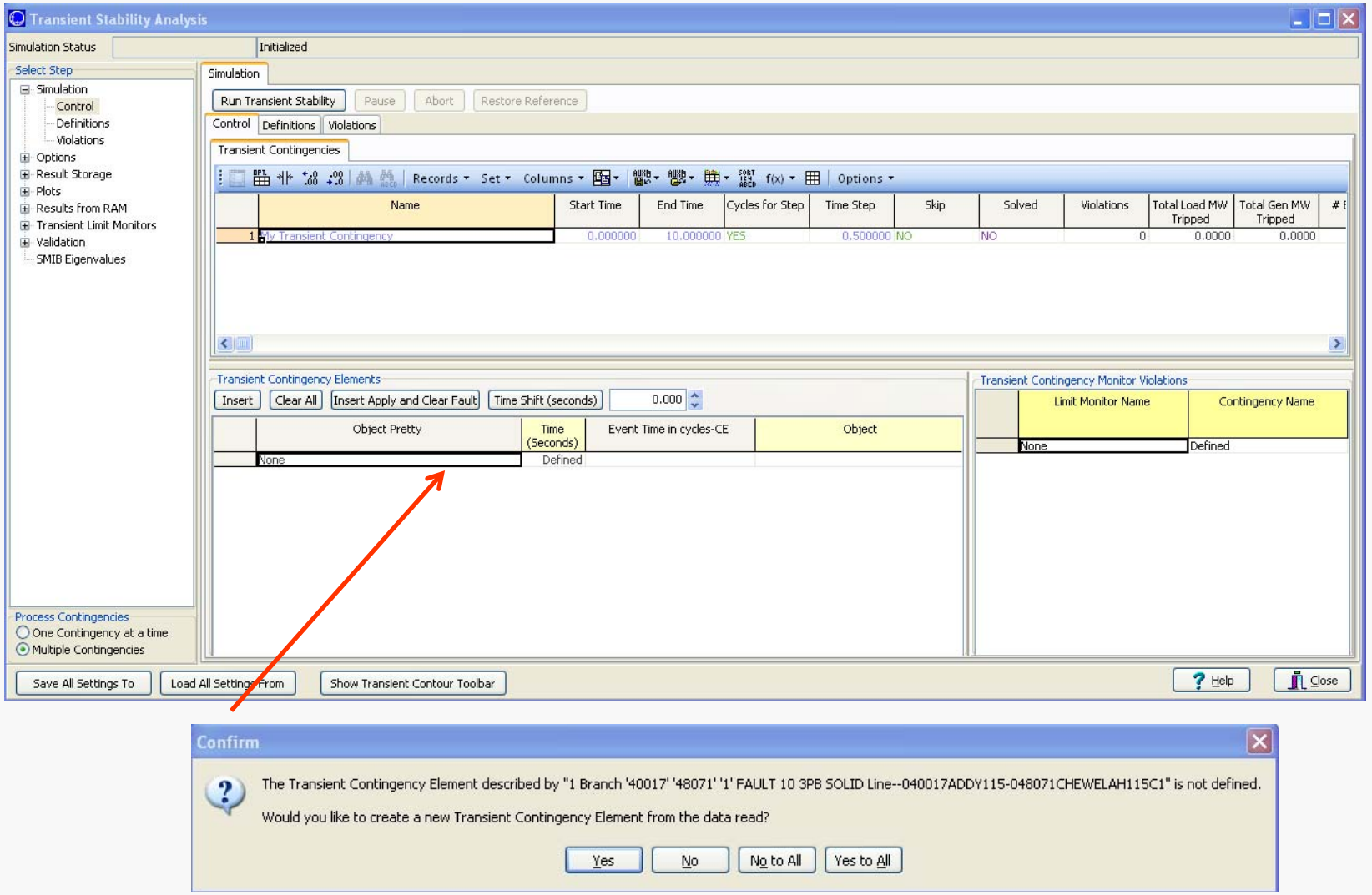
Cutting and Pasting

Book6

	A	B	C	D	E	F	G	H	I	J	K
1	ContingencyElement				Transient Stability Events						
2	Contingency Label	Object-CSE			Object Pretty	Time (Seconds)	Object	Description	Enabled	Model Crit	Contingency Name
3	Line--040017ADDY115-048071CHEWELAH115C1	Branch '40017' '48071' '1'			Line BOULDER TO RATHDRUM CKT 1	1	Branch '48524' '48357' '1'	FAULT 10 3PB SOLID	CHECK		My Transient Contingency
4	Line--040017ADDY115-048135GIFFORD115C1	Branch '40017' '48135' '1'			Line BOULDER TO RATHDRUM CKT 1	1.083	Branch '48524' '48357' '1'	OPEN NEAR	CHECK		My Transient Contingency
5	Line--040017ADDY115-048223METCHIP115C1	Branch '40017' '48223' '1'			Line BOULDER TO RATHDRUM CKT 1	1.083	Branch '48524' '48357' '1'	OPEN FAR	CHECK		My Transient Contingency
6	Line--040023AHSAHKA115-048303OROFINO115C1	Branch '40023' '48303' '1'									
7	Line--048029BEACONS115-040087BELLBPA115C1	Branch '48029' '40087' '1'									
8	Line--040087BELLBPA115-048033BELLTAP115C1	Branch '40087' '48033' '1'									
9	Line--040087BELLBPA115-048449WAIKIKIT115C1	Branch '40087' '48449' '1'									
10	Line--048025BEACONN230-040090BELLS3230C5	Branch '48025' '40090' '5'									
11	Line--048031BEACONS230-040092BELLS4230C4	Branch '48031' '40092' '4'									
12	Line--040149BRINKENS115-048341POTLATA115C1	Branch '40149' '48341' '1'									
13	Line--040149BRINKENS115-048445VIOLA115C1	Branch '40149' '48445' '1'									
14	Line--048079COLBERT115-040255COLBERTT115C1	Branch '48079' '40255' '1'									
15	Line--048119EGRANTAP115-040383EGRANVIL115C1	Branch '48119' '40383' '1'									
16	Line--048009AIRWAYHT115-040397FAIRCHLD115C1	Branch '48009' '40397' '1'									
17	Line--040397FAIRCHLD115-048388SILVRLK2115C1	Branch '40397' '48388' '1'									
18	Line--040449GAFFNEY115-048363REARDAN115C1	Branch '40449' '48363' '1'									
19	Line--040449GAFFNEY115-048411SPRAGUE115C1	Branch '40449' '48411' '1'									
20	Line--040519HATWAI230-048197LOLO230C1	Branch '40519' '48197' '1'									
21	Line--040519HATWAI230-048249MOSCOW230C1	Branch '40519' '48249' '1'									
22	Line--040519HATWAI230-048255NLEWIST230C1	Branch '40519' '48255' '1'									
23	Line--048125FOURLBPA115-040525HAYFORD115C1	Branch '48125' '40525' '1'									
24	Line--048131GARDENSP115-040525HAYFORD115C1	Branch '48131' '40525' '1'									
25	Line--040551HOTSPR230-048281NOXON230C2	Branch '40551' '48281' '2'									
26	Line--040577IRBY115-048295ODESSA115C1	Branch '40577' '48295' '1'									
27	Line--040577IRBY115-048471WILSNCKT115C1	Branch '40577' '48471' '1'									
28	Line--040607KETTLET115-048175KETTLEAV115C1	Branch '40607' '48175' '1'									
29	Line--048222MEADSUB115-040730MEADTAP115C1	Branch '48222' '40730' '1'									
30	Line--040657LIBBY230-040787NOXONBPA230C1-MS	Branch '40790' '40787' '1'									
31	Line--048281NOXON230-040787NOXONBPA230C1	Branch '48281' '40787' '1'									
32	Line--040787NOXONBPA230-048289NOXONCON230	Branch '40787' '48289' '1'									
33	Line--048329POSTFLS115-040855PRAIRIEB115C1	Branch '48329' '40855' '1'									
34	Line--040855PRAIRIEB115-048349RAMSEY115C1	Branch '40855' '48349' '1'									
35	Line--048017ATHOLTAP115-040953SCARCELO115C1	Branch '48017' '40953' '1'									
36	Line--048356RATHDRME115-040953SCARCELO115C1	Branch '48356' '40953' '1'									
37	Line--048299OPPORTUN115-041107VALYWAY115C1	Branch '48299' '41107' '1'									

ContingencyElement | Transient Stability Events

Pasting Here (three times)



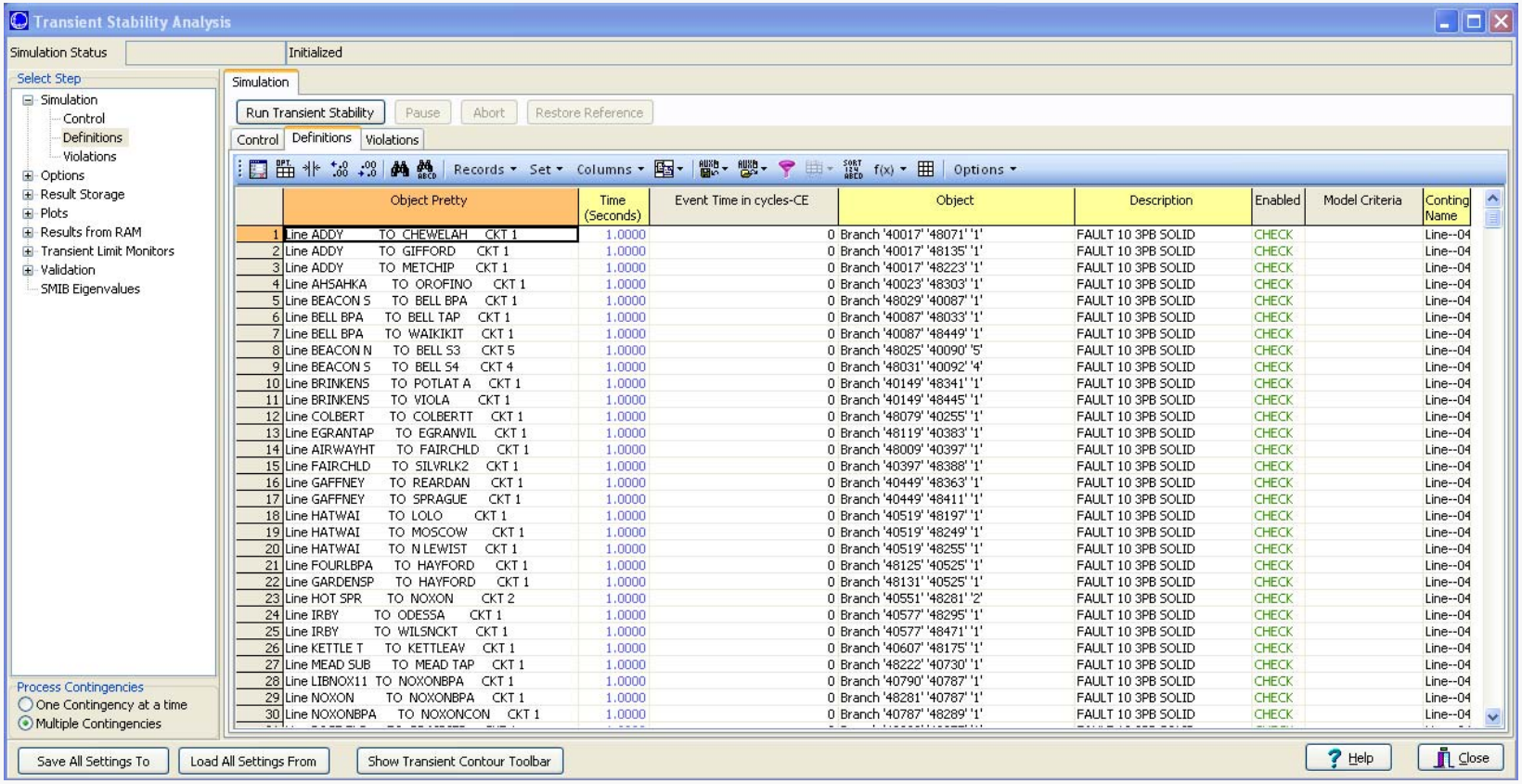
First Paste (Fault On)

Book6

	A	B	C	D
1	Transient Stability Events			
2	Contingency Name	Object	Time (Seconds)	Description
3	Line--040017ADDY115-048071CHEWELAH115C1	Branch '40017' '48071' '1'	1	FAULT 10 3PB SOLID
4	Line--040017ADDY115-048135GIFFORD115C1	Branch '40017' '48135' '1'	1	FAULT 10 3PB SOLID
5	Line--040017ADDY115-048223METCHIP115C1	Branch '40017' '48223' '1'	1	FAULT 10 3PB SOLID
6	Line--040023AHSAHKA115-048303OROFINO115C1	Branch '40023' '48303' '1'	1	FAULT 10 3PB SOLID
7	Line--048029BEACONS115-040087BELLBPA115C1	Branch '48029' '40087' '1'	1	FAULT 10 3PB SOLID
8	Line--040087BELLBPA115-048033BELLTAP115C1	Branch '40087' '48033' '1'	1	FAULT 10 3PB SOLID
9	Line--040087BELLBPA115-048449WAIKIKIT115C1	Branch '40087' '48449' '1'	1	FAULT 10 3PB SOLID
10	Line--048025BEACONN230-040090BELLS3230C5	Branch '48025' '40090' '5'	1	FAULT 10 3PB SOLID
11	Line--048031BEACONS230-040092BELLS4230C4	Branch '48031' '40092' '4'	1	FAULT 10 3PB SOLID
12	Line--040149BRINKENS115-048341POTLATA115C1	Branch '40149' '48341' '1'	1	FAULT 10 3PB SOLID
13	Line--040149BRINKENS115-048445VIOLA115C1	Branch '40149' '48445' '1'	1	FAULT 10 3PB SOLID
14	Line--048079COLBERT115-040255COLBERTT115C1	Branch '48079' '40255' '1'	1	FAULT 10 3PB SOLID
15	Line--048119EGRANTAP115-040383EGRANVIL115C1	Branch '48119' '40383' '1'	1	FAULT 10 3PB SOLID
16	Line--048009AIRWAYHT115-040397FAIRCHLD115C1	Branch '48009' '40397' '1'	1	FAULT 10 3PB SOLID
17	Line--040397FAIRCHLD115-048388SILVRLK2115C1	Branch '40397' '48388' '1'	1	FAULT 10 3PB SOLID
18	Line--040449GAFFNEY115-048363REARDAN115C1	Branch '40449' '48363' '1'	1	FAULT 10 3PB SOLID
19	Line--040449GAFFNEY115-048411SPRAGUE115C1	Branch '40449' '48411' '1'	1	FAULT 10 3PB SOLID
20	Line--040519HATWAI230-048197LOLO230C1	Branch '40519' '48197' '1'	1	FAULT 10 3PB SOLID
21	Line--040519HATWAI230-048249MOSCOW230C1	Branch '40519' '48249' '1'	1	FAULT 10 3PB SOLID
22	Line--040519HATWAI230-048255NLEWIST230C1	Branch '40519' '48255' '1'	1	FAULT 10 3PB SOLID
23	Line--048125FOURLBPA115-040525HAYFORD115C1	Branch '48125' '40525' '1'	1	FAULT 10 3PB SOLID
24	Line--048131GARDENSP115-040525HAYFORD115C1	Branch '48131' '40525' '1'	1	FAULT 10 3PB SOLID
25	Line--040551HOTSPR230-048281NOXON230C2	Branch '40551' '48281' '2'	1	FAULT 10 3PB SOLID
26	Line--040577IRBY115-048295ODESSA115C1	Branch '40577' '48295' '1'	1	FAULT 10 3PB SOLID
27	Line--040577IRBY115-048471WILSNCKT115C1	Branch '40577' '48471' '1'	1	FAULT 10 3PB SOLID
28	Line--040607KETTLET115-048175KETTLEAV115C1	Branch '40607' '48175' '1'	1	FAULT 10 3PB SOLID
29	Line--048222MEADSUB115-040730MEADTAP115C1	Branch '48222' '40730' '1'	1	FAULT 10 3PB SOLID
30	Line--040657LIBBY230-040787NOXONBPA230C1-MS	Branch '40790' '40787' '1'	1	FAULT 10 3PB SOLID
31	Line--048281NOXON230-040787NOXONBPA230C1	Branch '48281' '40787' '1'	1	FAULT 10 3PB SOLID
32	Line--040787NOXONBPA230-048289NOXONCON230	Branch '40787' '48289' '1'	1	FAULT 10 3PB SOLID
33	Line--048329POSTFLS115-040855PRAIRIEB115C1	Branch '48329' '40855' '1'	1	FAULT 10 3PB SOLID
34	Line--040855PRAIRIEB115-048349RAMSEY115C1	Branch '40855' '48349' '1'	1	FAULT 10 3PB SOLID
35	Line--048017ATHOLTAP115-040953SCARCELO115C1	Branch '48017' '40953' '1'	1	FAULT 10 3PB SOLID
36	Line--048356RATHDRME115-040953SCARCELO115C1	Branch '48356' '40953' '1'	1	FAULT 10 3PB SOLID
37	Line--048299OPPORTUN115-041107VALYWAY115C1	Branch '48299' '41107' '1'	1	FAULT 10 3PB SOLID

ContingencyElement | Transient Stability Events

Refresh (Definitions)



Second Paste (Open Near)

Book6

	A	B	C	D
1	Transient Stability Events			
2	Contingency Name	Object	Time (Seconds)	Description
3	Line--040017ADDY115-048071CHEWELAH115C1	Branch '40017' '48071' '1'	1.083	OPEN NEAR
4	Line--040017ADDY115-048135GIFFORD115C1	Branch '40017' '48135' '1'	1.083	OPEN NEAR
5	Line--040017ADDY115-048223METCHIP115C1	Branch '40017' '48223' '1'	1.083	OPEN NEAR
6	Line--040023AHSAHKA115-048303OROFINO115C1	Branch '40023' '48303' '1'	1.083	OPEN NEAR
7	Line--048029BEACONS115-040087BELLBPA115C1	Branch '48029' '40087' '1'	1.083	OPEN NEAR
8	Line--040087BELLBPA115-048033BELLTAP115C1	Branch '40087' '48033' '1'	1.083	OPEN NEAR
9	Line--040087BELLBPA115-048449WAIKIKIT115C1	Branch '40087' '48449' '1'	1.083	OPEN NEAR
10	Line--048025BEACONN230-040090BELLS3230C5	Branch '48025' '40090' '5'	1.083	OPEN NEAR
11	Line--048031BEACONS230-040092BELLS4230C4	Branch '48031' '40092' '4'	1.083	OPEN NEAR
12	Line--040149BRINKENS115-048341POTLATA115C1	Branch '40149' '48341' '1'	1.083	OPEN NEAR
13	Line--040149BRINKENS115-048445VIOLA115C1	Branch '40149' '48445' '1'	1.083	OPEN NEAR
14	Line--048079COLBERT115-040255COLBERTT115C1	Branch '48079' '40255' '1'	1.083	OPEN NEAR
15	Line--048119EGRANTAP115-040383EGRANVIL115C1	Branch '48119' '40383' '1'	1.083	OPEN NEAR
16	Line--048009AIRWAYHT115-040397FAIRCHLD115C1	Branch '48009' '40397' '1'	1.083	OPEN NEAR
17	Line--040397FAIRCHLD115-048388SILVRLK2115C1	Branch '40397' '48388' '1'	1.083	OPEN NEAR
18	Line--040449GAFFNEY115-048363REARDAN115C1	Branch '40449' '48363' '1'	1.083	OPEN NEAR
19	Line--040449GAFFNEY115-048411SPRAGUE115C1	Branch '40449' '48411' '1'	1.083	OPEN NEAR
20	Line--040519HATWAI230-048197LOLO230C1	Branch '40519' '48197' '1'	1.083	OPEN NEAR
21	Line--040519HATWAI230-048249MOSCOW230C1	Branch '40519' '48249' '1'	1.083	OPEN NEAR
22	Line--040519HATWAI230-048255NLEWIST230C1	Branch '40519' '48255' '1'	1.083	OPEN NEAR
23	Line--048125FOURLBPA115-040525HAYFORD115C1	Branch '48125' '40525' '1'	1.083	OPEN NEAR
24	Line--048131GARDENSP115-040525HAYFORD115C1	Branch '48131' '40525' '1'	1.083	OPEN NEAR
25	Line--040551HOTSPR230-048281NOXON230C2	Branch '40551' '48281' '2'	1.083	OPEN NEAR
26	Line--040577IRBY115-048295ODESSA115C1	Branch '40577' '48295' '1'	1.083	OPEN NEAR
27	Line--040577IRBY115-048471WILSNCKT115C1	Branch '40577' '48471' '1'	1.083	OPEN NEAR
28	Line--040607KETTLET115-048175KETTLEAV115C1	Branch '40607' '48175' '1'	1.083	OPEN NEAR
29	Line--048222MEADSUB115-040730MEADTAP115C1	Branch '48222' '40730' '1'	1.083	OPEN NEAR
30	Line--040657LIBBY230-040787NOXONBPA230C1-MS	Branch '40790' '40787' '1'	1.083	OPEN NEAR
31	Line--048281NOXON230-040787NOXONBPA230C1	Branch '48281' '40787' '1'	1.083	OPEN NEAR
32	Line--040787NOXONBPA230-048289NOXONCON23(	Branch '40787' '48289' '1'	1.083	OPEN NEAR
33	Line--048329POSTFLS115-040855PRAIRIEB115C1	Branch '48329' '40855' '1'	1.083	OPEN NEAR
34	Line--040855PRAIRIEB115-048349RAMSEY115C1	Branch '40855' '48349' '1'	1.083	OPEN NEAR
35	Line--048017ATHOLTAP115-040953SCARCELO115C1	Branch '48017' '40953' '1'	1.083	OPEN NEAR
36	Line--048356RATHDRME115-040953SCARCELO115C1	Branch '48356' '40953' '1'	1.083	OPEN NEAR
37	Line--048299OPPORTUN115-041107VALYWAY115C1	Branch '48299' '41107' '1'	33	OPEN NEAR

ContingencyElement | Transient Stability Events

Third Paste (Open Far)

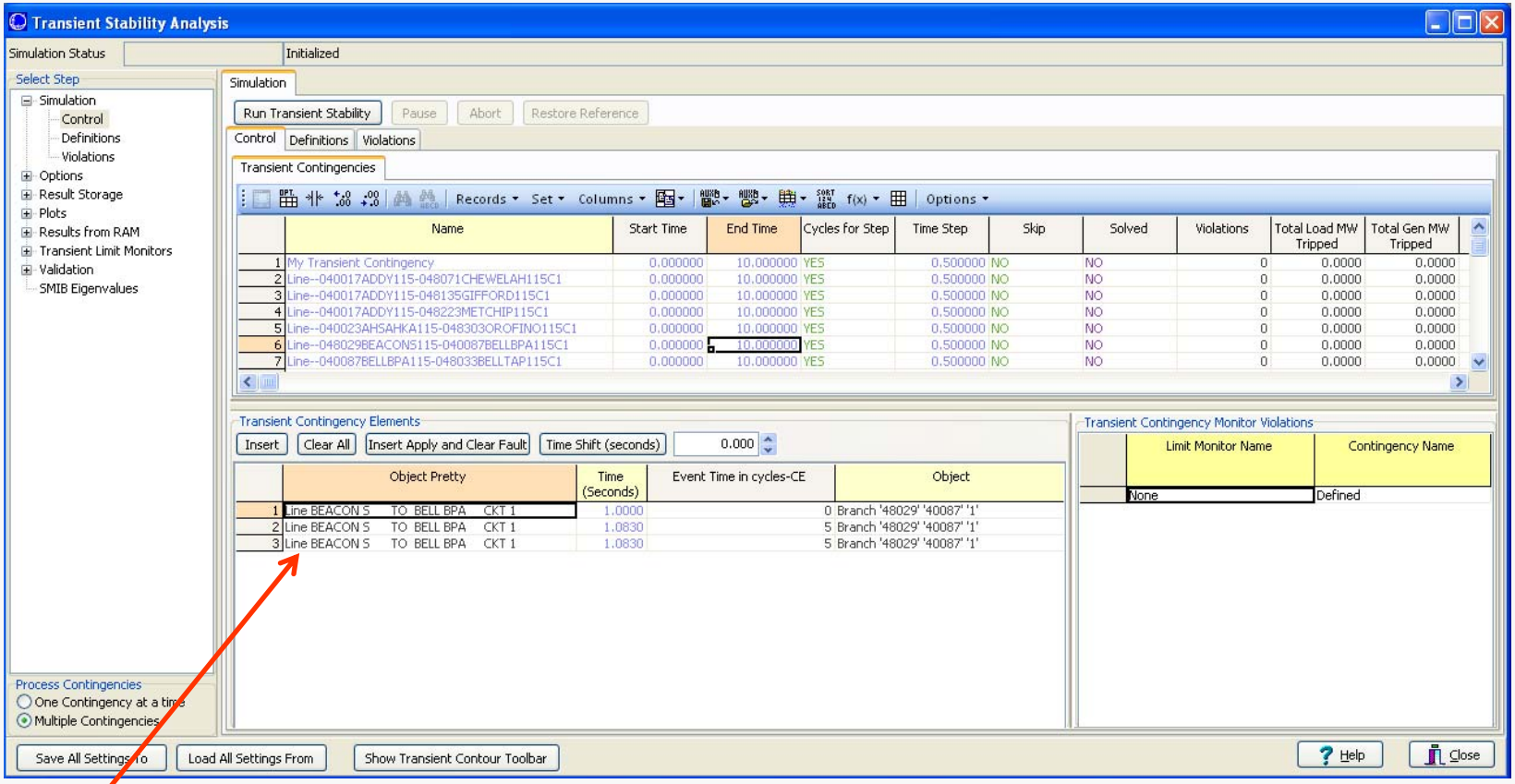
Book6

	A	B	C	D
1	Transient Stability Events			
2	Contingency Name	Object	Time (Seconds)	Description
3	Line--040017ADDY115-048071CHEWELAH115C1	Branch '40017' '48071' '1'	1.083	OPEN FAR
4	Line--040017ADDY115-048135GIFFORD115C1	Branch '40017' '48135' '1'	1.083	OPEN FAR
5	Line--040017ADDY115-048223METCHIP115C1	Branch '40017' '48223' '1'	1.083	OPEN FAR
6	Line--040023AHSAHKA115-048303OROFINO115C1	Branch '40023' '48303' '1'	1.083	OPEN FAR
7	Line--048029BEACONS115-040087BELLBPA115C1	Branch '48029' '40087' '1'	1.083	OPEN FAR
8	Line--040087BELLBPA115-048033BELLTAP115C1	Branch '40087' '48033' '1'	1.083	OPEN FAR
9	Line--040087BELLBPA115-048449WAIKIKIT115C1	Branch '40087' '48449' '1'	1.083	OPEN FAR
10	Line--048025BEACONN230-040090BELLS3230C5	Branch '48025' '40090' '5'	1.083	OPEN FAR
11	Line--048031BEACONS230-040092BELLS4230C4	Branch '48031' '40092' '4'	1.083	OPEN FAR
12	Line--040149BRINKENS115-048341POTLATA115C1	Branch '40149' '48341' '1'	1.083	OPEN FAR
13	Line--040149BRINKENS115-048445VIOLA115C1	Branch '40149' '48445' '1'	1.083	OPEN FAR
14	Line--048079COLBERT115-040255COLBERTT115C1	Branch '48079' '40255' '1'	1.083	OPEN FAR
15	Line--048119EGRANTAP115-040383EGRANVIL115C1	Branch '48119' '40383' '1'	1.083	OPEN FAR
16	Line--048009AIRWAYHT115-040397FAIRCHLD115C1	Branch '48009' '40397' '1'	1.083	OPEN FAR
17	Line--040397FAIRCHLD115-048388SILVRLK2115C1	Branch '40397' '48388' '1'	1.083	OPEN FAR
18	Line--040449GAFFNEY115-048363REARDAN115C1	Branch '40449' '48363' '1'	1.083	OPEN FAR
19	Line--040449GAFFNEY115-048411SPRAGUE115C1	Branch '40449' '48411' '1'	1.083	OPEN FAR
20	Line--040519HATWAI230-048197LOLO230C1	Branch '40519' '48197' '1'	1.083	OPEN FAR
21	Line--040519HATWAI230-048249MOSCOW230C1	Branch '40519' '48249' '1'	1.083	OPEN FAR
22	Line--040519HATWAI230-048255NLEWIST230C1	Branch '40519' '48255' '1'	1.083	OPEN FAR
23	Line--048125FOURLBPA115-040525HAYFORD115C1	Branch '48125' '40525' '1'	1.083	OPEN FAR
24	Line--048131GARDENSP115-040525HAYFORD115C1	Branch '48131' '40525' '1'	1.083	OPEN FAR
25	Line--040551HOTSPR230-048281NOXON230C2	Branch '40551' '48281' '2'	1.083	OPEN FAR
26	Line--040577IRBY115-048295ODESSA115C1	Branch '40577' '48295' '1'	1.083	OPEN FAR
27	Line--040577IRBY115-048471WILSNCKT115C1	Branch '40577' '48471' '1'	1.083	OPEN FAR
28	Line--040607KETTLET115-048175KETTLEAV115C1	Branch '40607' '48175' '1'	1.083	OPEN FAR
29	Line--048222MEADSUB115-040730MEADTAP115C1	Branch '48222' '40730' '1'	1.083	OPEN FAR
30	Line--040657LIBBY230-040787NOXONBPA230C1-MS	Branch '40790' '40787' '1'	1.083	OPEN FAR
31	Line--048281NOXON230-040787NOXONBPA230C1	Branch '48281' '40787' '1'	1.083	OPEN FAR
32	Line--040787NOXONBPA230-048289NOXONCON23(	Branch '40787' '48289' '1'	1.083	OPEN FAR
33	Line--048329POSTFLS115-040855PRAIRIEB115C1	Branch '48329' '40855' '1'	1.083	OPEN FAR
34	Line--040855PRAIRIEB115-048349RAMSEY115C1	Branch '40855' '48349' '1'	1.083	OPEN FAR
35	Line--048017ATHOLTAP115-040953SCARCELO115C1	Branch '48017' '40953' '1'	1.083	OPEN FAR
36	Line--048356RATHDRME115-040953SCARCELO115C1	Branch '48356' '40953' '1'	1.083	OPEN FAR
37	Line--048299OPPORTUN115-041107VALYWAY115C1	Branch '48299' '41107' '1'	33	OPEN FAR

ContingencyElement | Transient Stability Events

Pasting Results In This

Results: Knocked out 277 faults at 10% on From/Near End in 2 minutes.



Yay! The power of Object Orientated coding. Cut and paste is inherited and works in Transient Stability

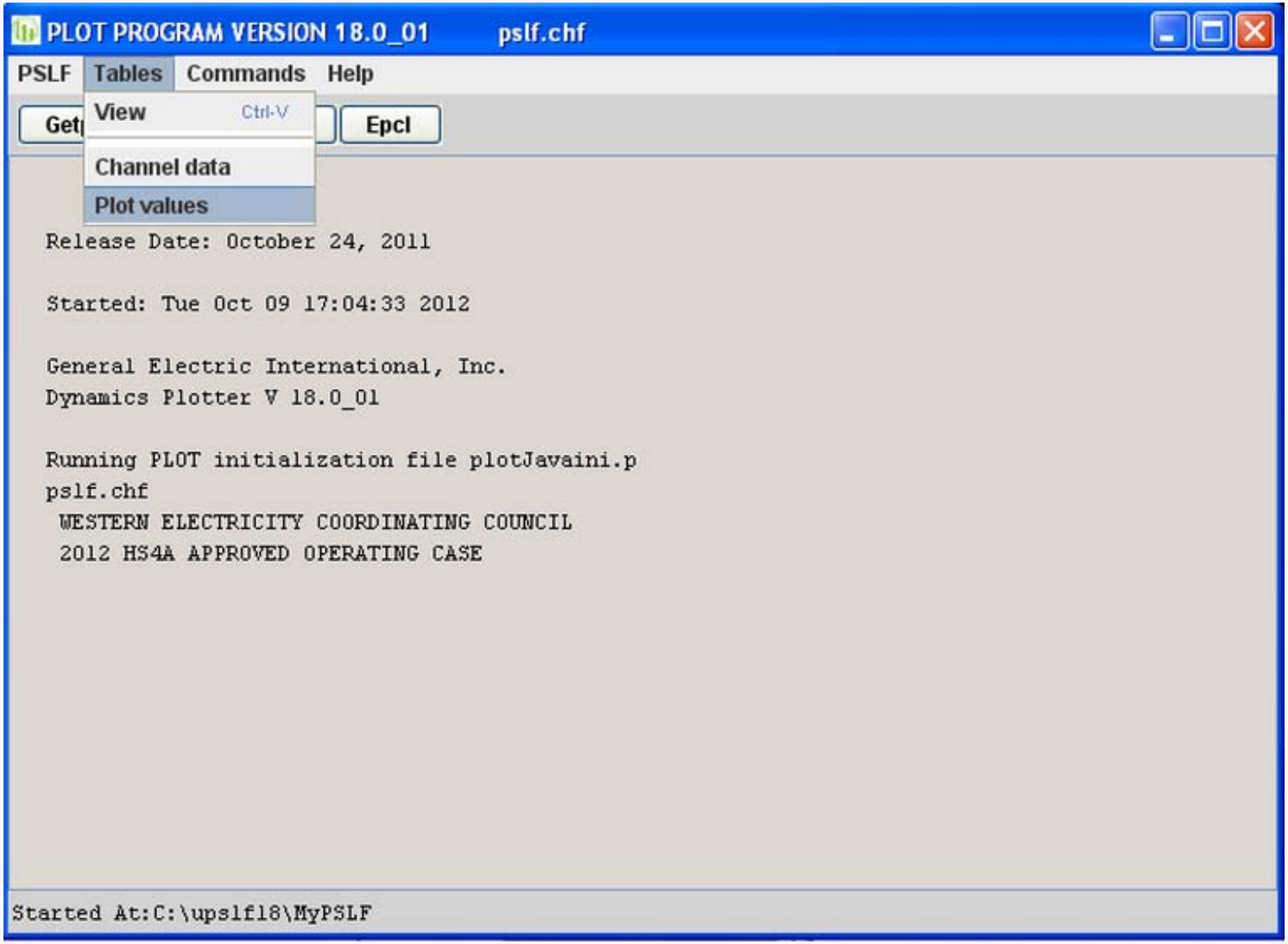
Alter Process/Results As Needed

- Suggestions
  - Sort out breaker timing with knowledge and filters
    - Cut and paste by breaker speed from PWS/Excel
    - Clean up timing in Excel
    - Clean up timing in PWS
    - All of the above is your call
- Bottom line
  - Cutting and pasting provides auto-insert like ability
    - You should be doing this once presumably

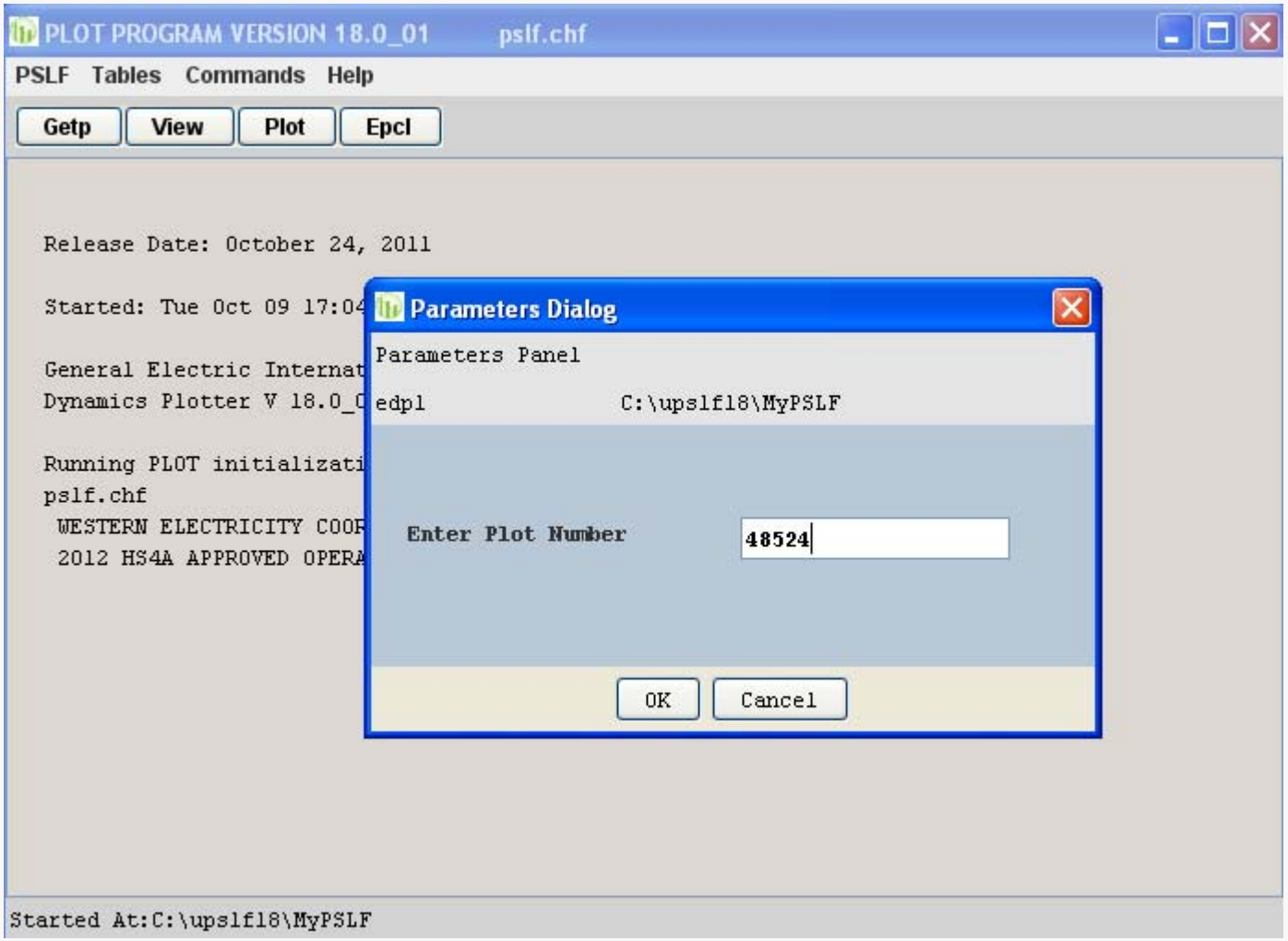
Comparison Using PlayIN

- Question is:
  - Is PowerWorld Simulator “Right”
    - Right = Correct **NUMERICAL** results
      - As compared to what?
        - » Ground truth = VALIDATION
        - » Another program = VERIFICATION
- Verification
  - Transient Stability
  - We can compare the numerical results
  - PlayIn

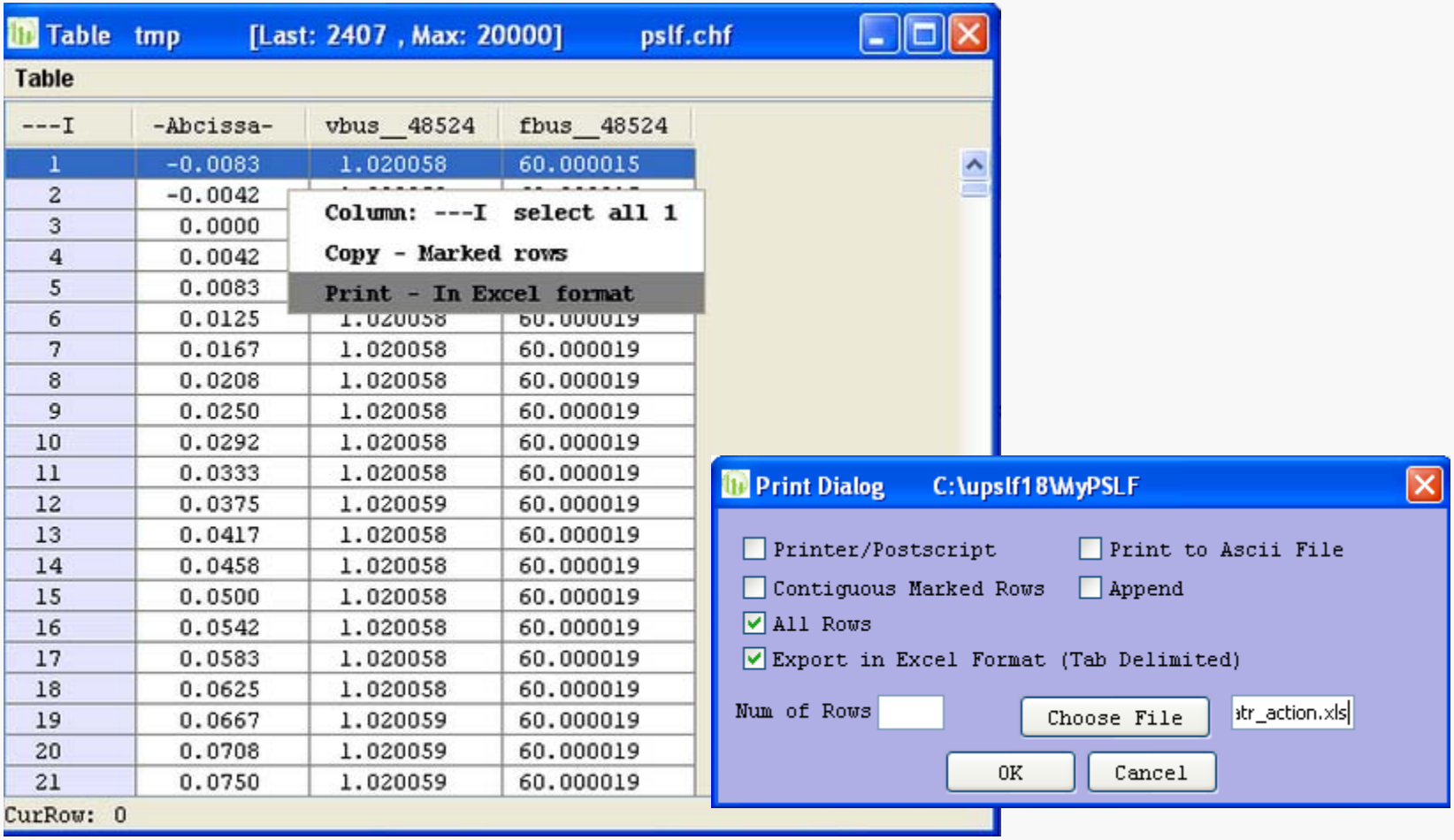
We Need Something To Play In



Query GE PSDS By Bus



Right Click GE To Save



Excel: Open File, Save As *.csv

- Open file in Excel and save it as a *.csv file
  - Inspection and proper formatting occur

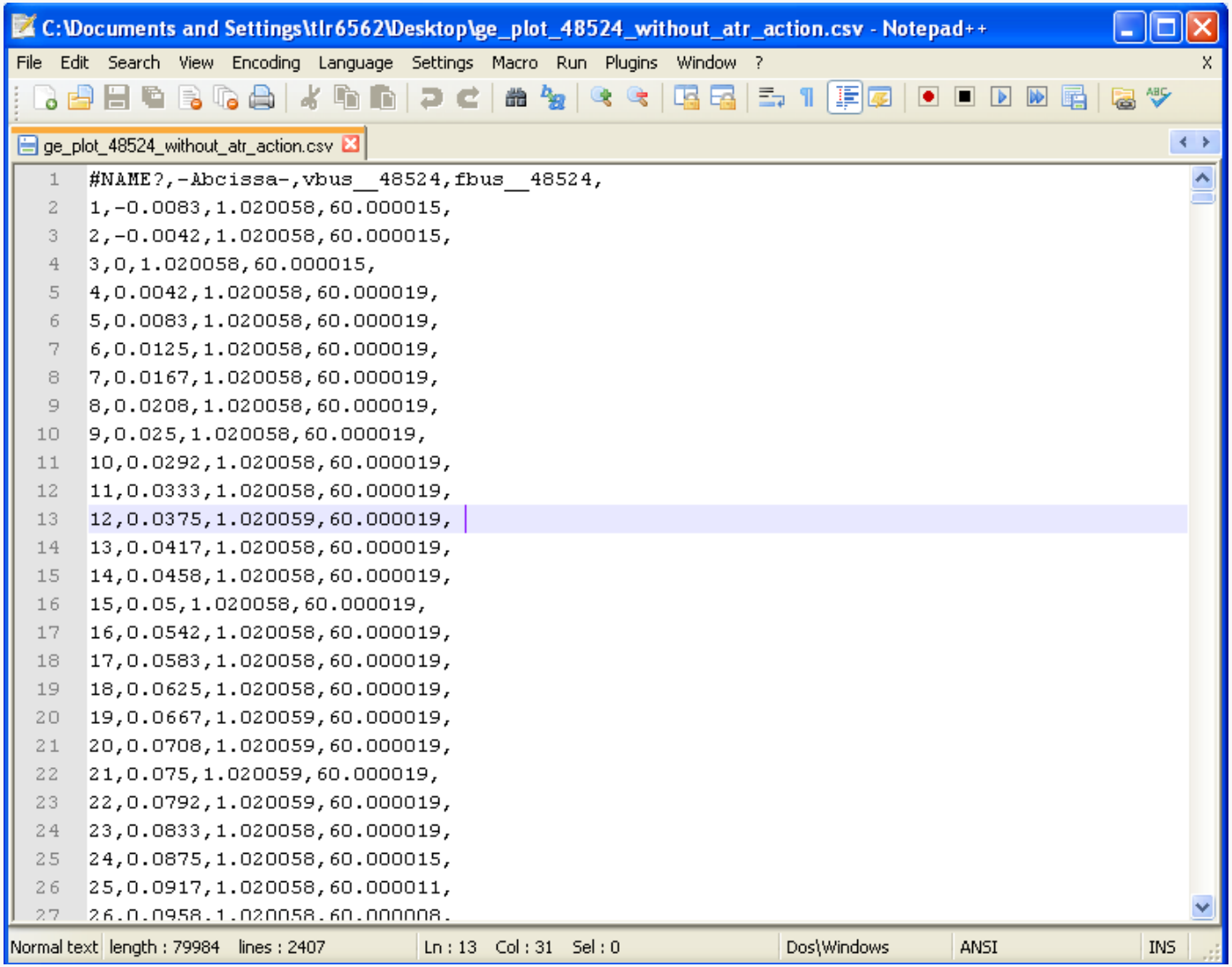
ge_plot_48524_without_atr_action.xls

	A	B	C	D	E	F
1	AME?	-Abcissa-	vbus__48524	fbus__48524		
2	1	-0.0083	1.020058	60.000015		
3	2	-0.0042	1.020058	60.000015		
4	3	0	1.020058	60.000015		
5	4	0.0042	1.020058	60.000019		
6	5	0.0083	1.020058	60.000019		
7	6	0.0125	1.020058	60.000019		
8	7	0.0167	1.020058	60.000019		
9	8	0.0208	1.020058	60.000019		
10	9	0.025	1.020058	60.000019		
11	10	0.0292	1.020058	60.000019		
12	11	0.0333	1.020058	60.000019		
13	12	0.0375	1.020059	60.000019		
14	13	0.0417	1.020058	60.000019		
15	14	0.0458	1.020058	60.000019		
16	15	0.05	1.020058	60.000019		
17	16	0.0542	1.020058	60.000019		
18	17	0.0583	1.020058	60.000019		
19	18	0.0625	1.020058	60.000019		
20	19	0.0667	1.020059	60.000019		
21	20	0.0708	1.020059	60.000019		
22	21	0.075	1.020059	60.000019		
23	22	0.0792	1.020059	60.000019		
24	23	0.0833	1.020058	60.000019		
25	24	0.0875	1.020058	60.000015		
26	25	0.0917	1.020058	60.000011		
27	26	0.0958	1.020058	60.000008		
28	27	0.1	1.020058	60.000004		
29	28	0.1042	1.020057	60		
30	29	0.1083	1.020056	59.999996		
31	30	0.1125	1.020054	59.999989		
32	31	0.1167	1.020051	59.999985		
33	32	0.1208	1.020048	59.999985		

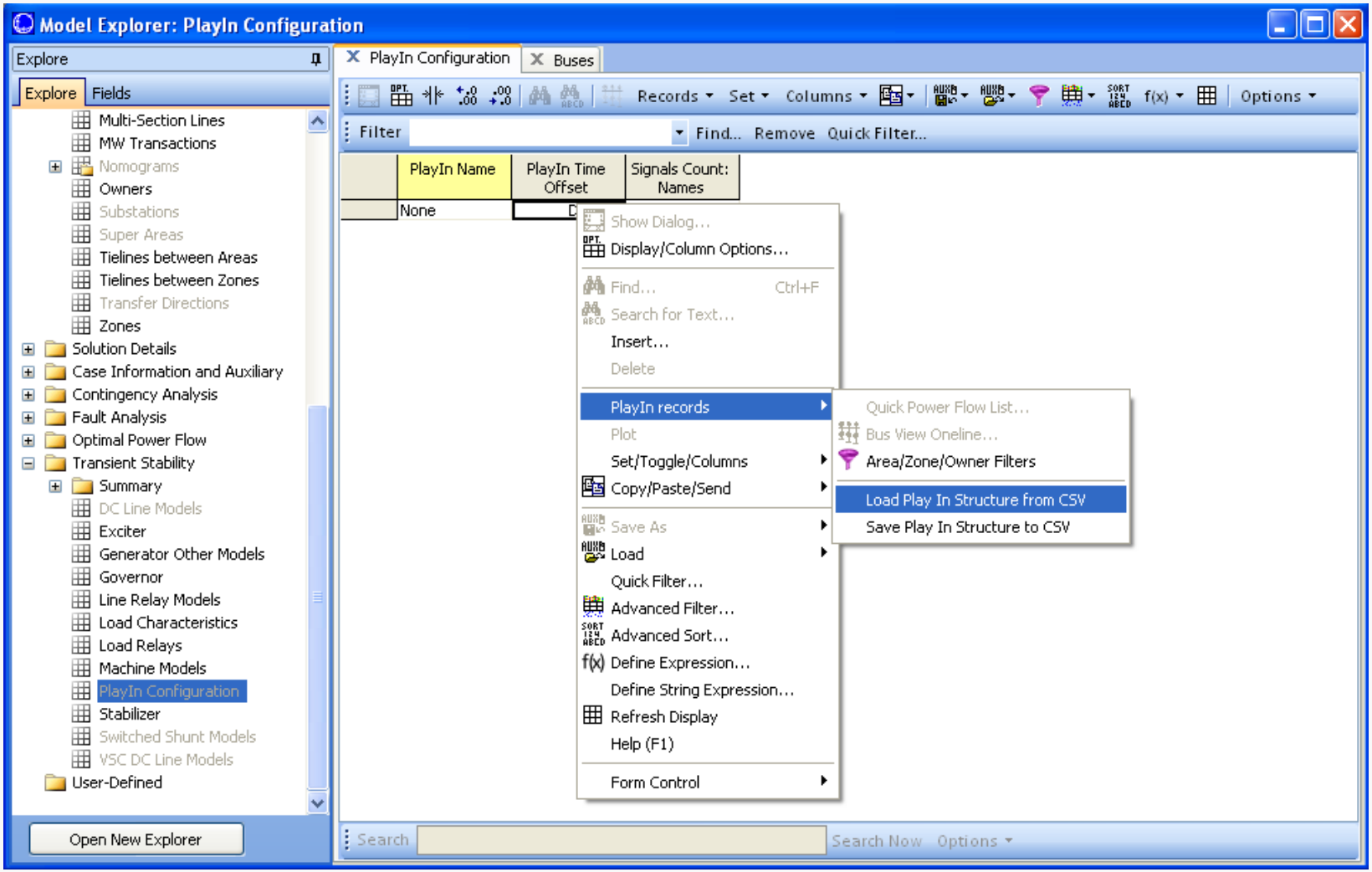
ge_plot_48524_without

After Saving As *.csv

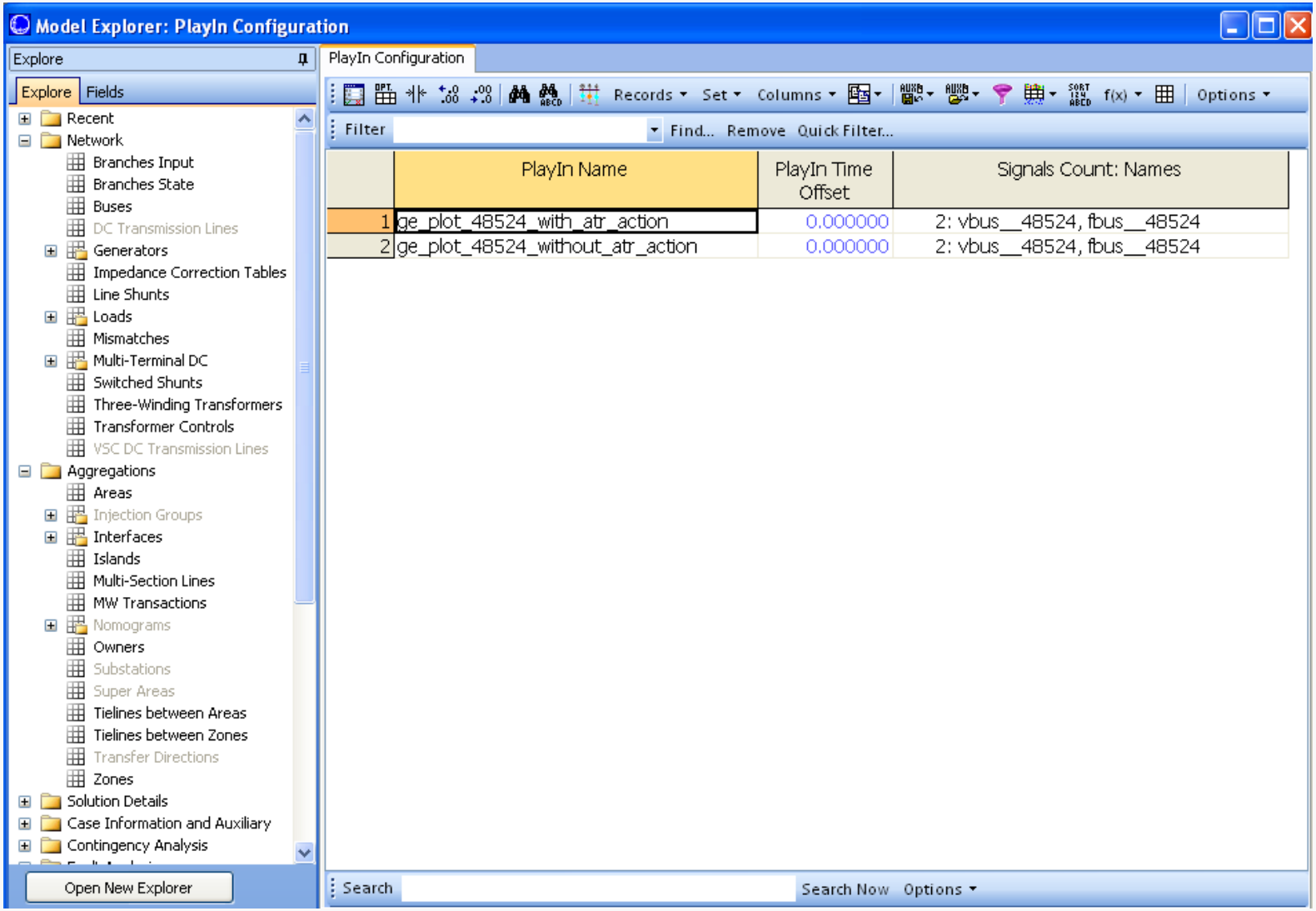
Notepad + + = Yay!



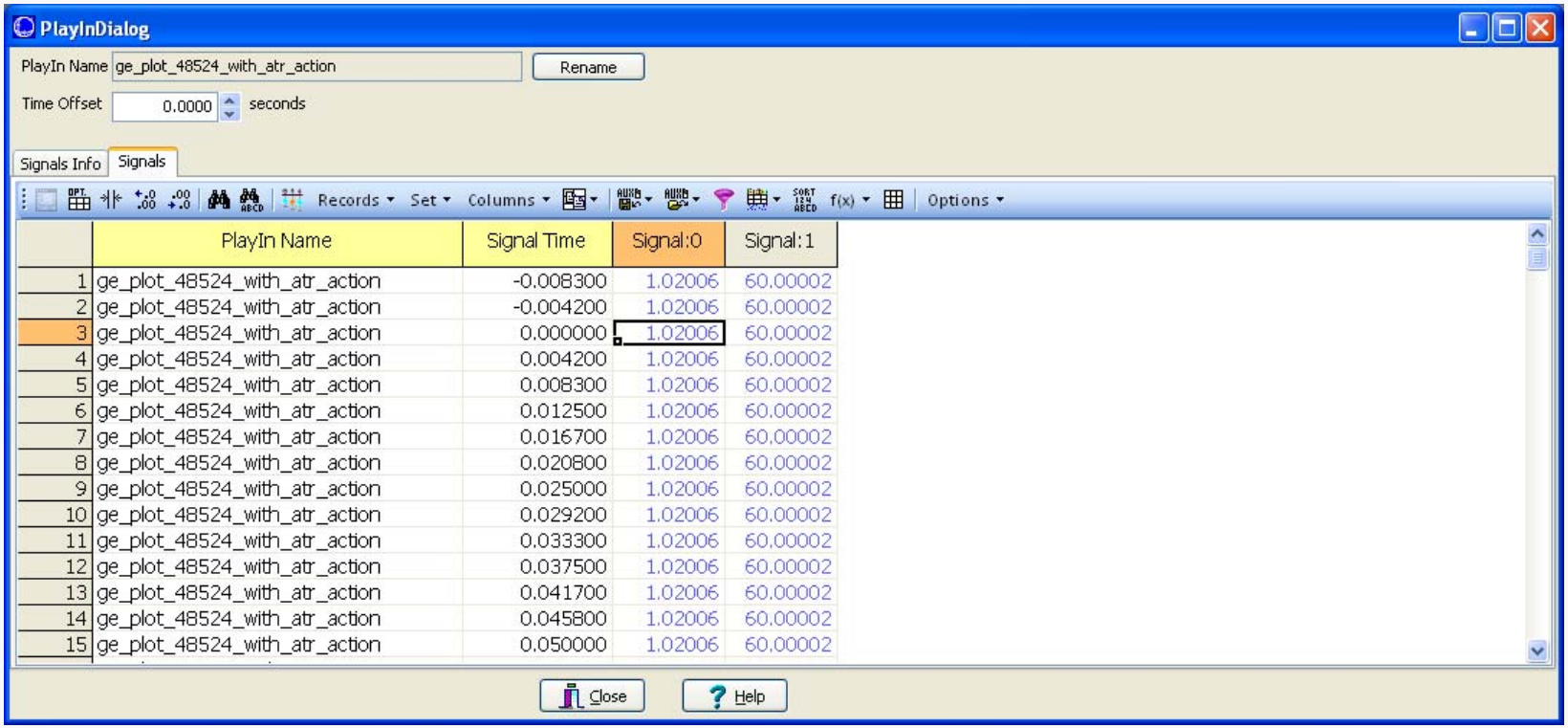
Read In *.csv As PlayIn



PlayIn Main Dialog

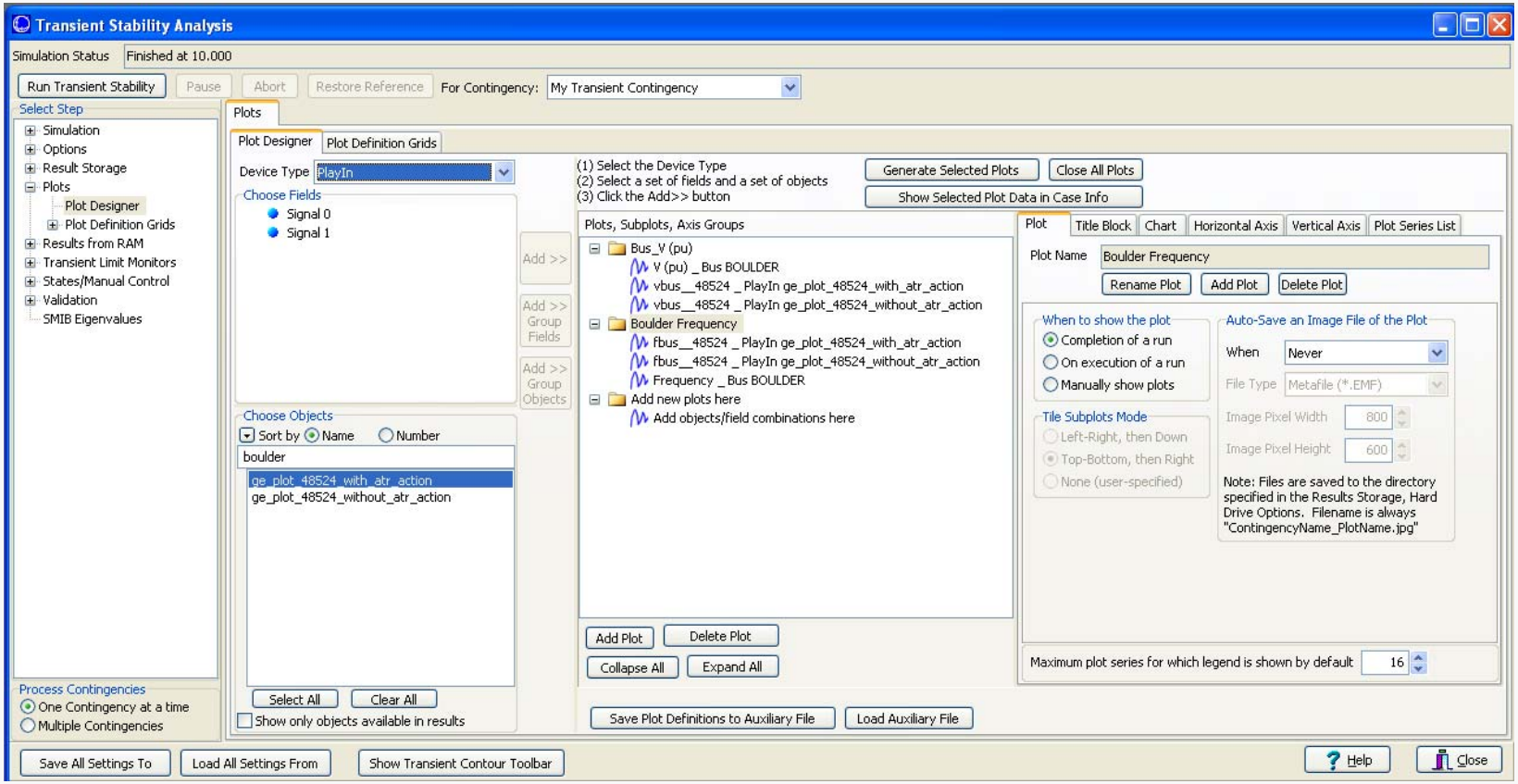


PlayIn Signals Dialog (The Data)

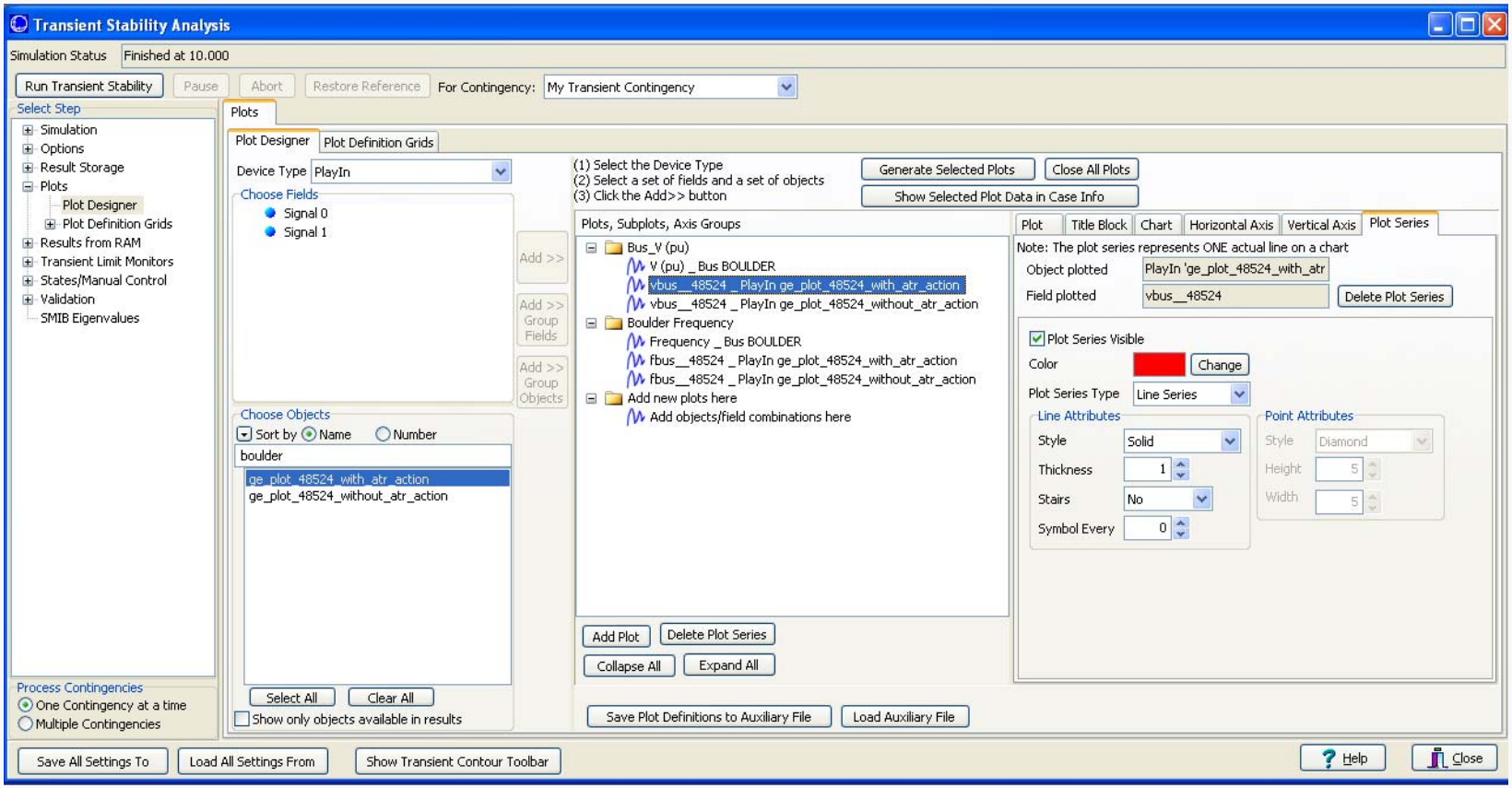


	PlayIn Name	Signal Time	Signal:0	Signal:1
1	ge_plot_48524_with_atr_action	-0.008300	1.02006	60.00002
2	ge_plot_48524_with_atr_action	-0.004200	1.02006	60.00002
3	ge_plot_48524_with_atr_action	0.000000	1.02006	60.00002
4	ge_plot_48524_with_atr_action	0.004200	1.02006	60.00002
5	ge_plot_48524_with_atr_action	0.008300	1.02006	60.00002
6	ge_plot_48524_with_atr_action	0.012500	1.02006	60.00002
7	ge_plot_48524_with_atr_action	0.016700	1.02006	60.00002
8	ge_plot_48524_with_atr_action	0.020800	1.02006	60.00002
9	ge_plot_48524_with_atr_action	0.025000	1.02006	60.00002
10	ge_plot_48524_with_atr_action	0.029200	1.02006	60.00002
11	ge_plot_48524_with_atr_action	0.033300	1.02006	60.00002
12	ge_plot_48524_with_atr_action	0.037500	1.02006	60.00002
13	ge_plot_48524_with_atr_action	0.041700	1.02006	60.00002
14	ge_plot_48524_with_atr_action	0.045800	1.02006	60.00002
15	ge_plot_48524_with_atr_action	0.050000	1.02006	60.00002

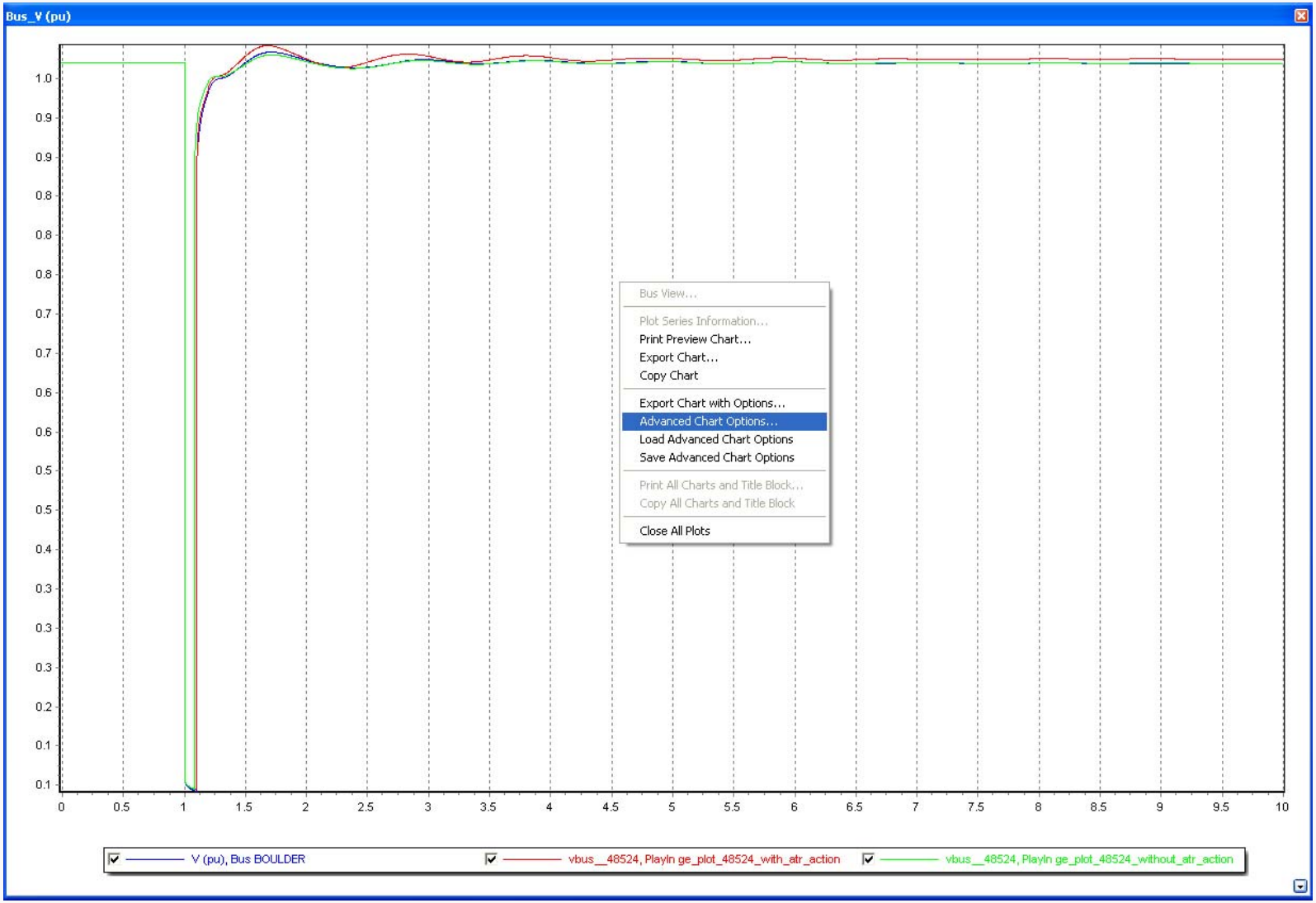
Plotting a PlayIn



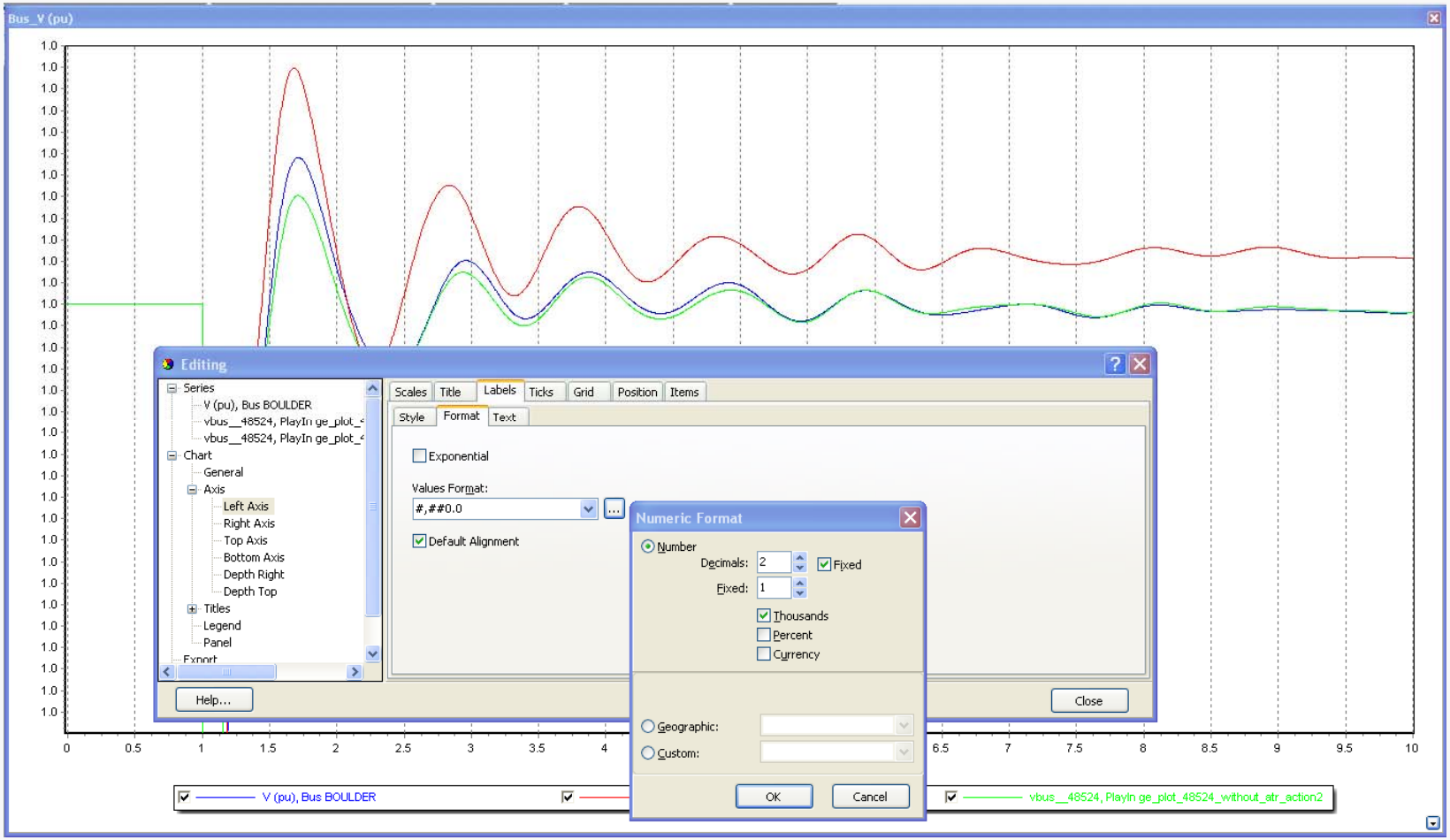
Play With Colors To Compare



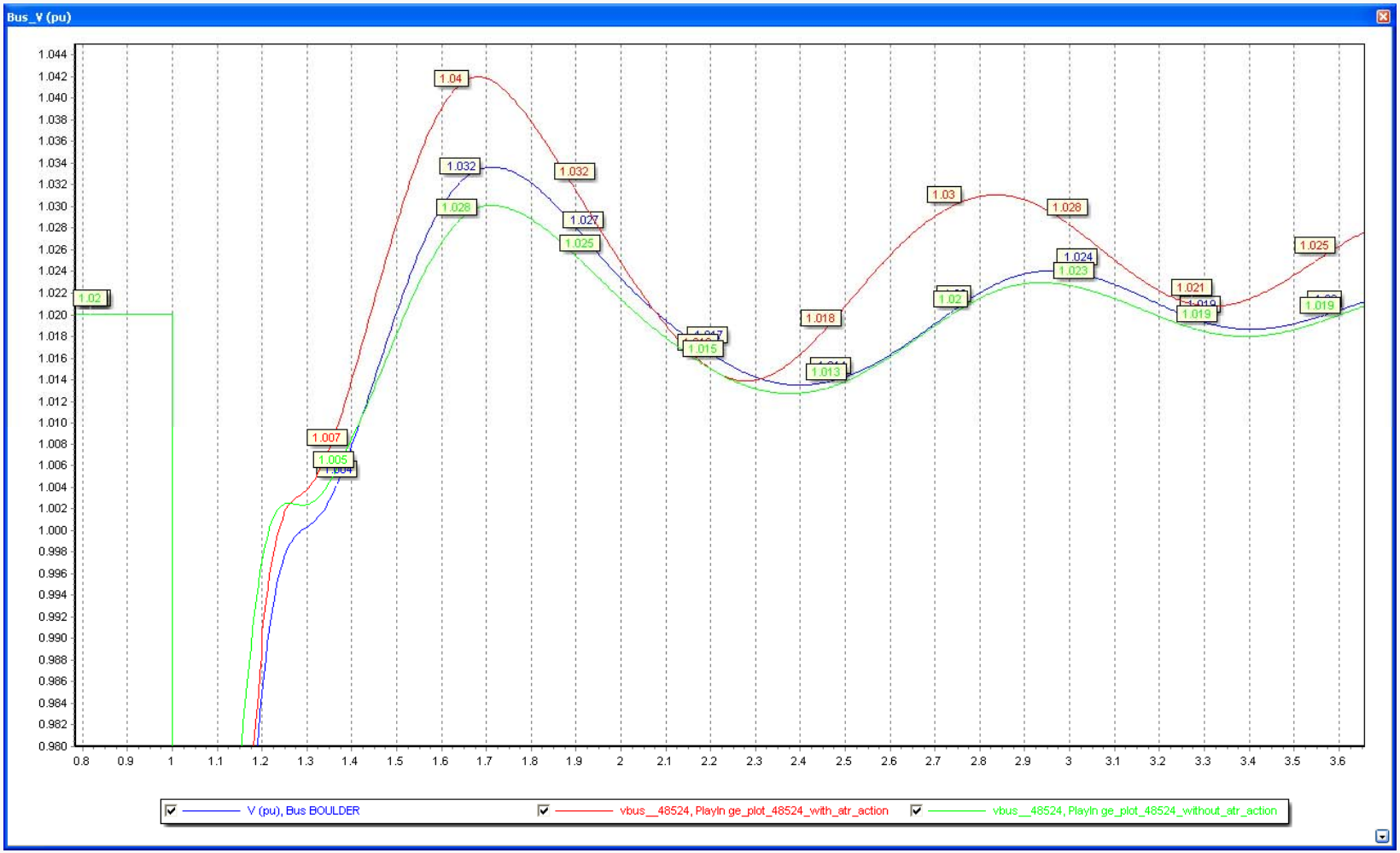
Adjust Plots For Comparison



Scale, Decimal Points, Gridline

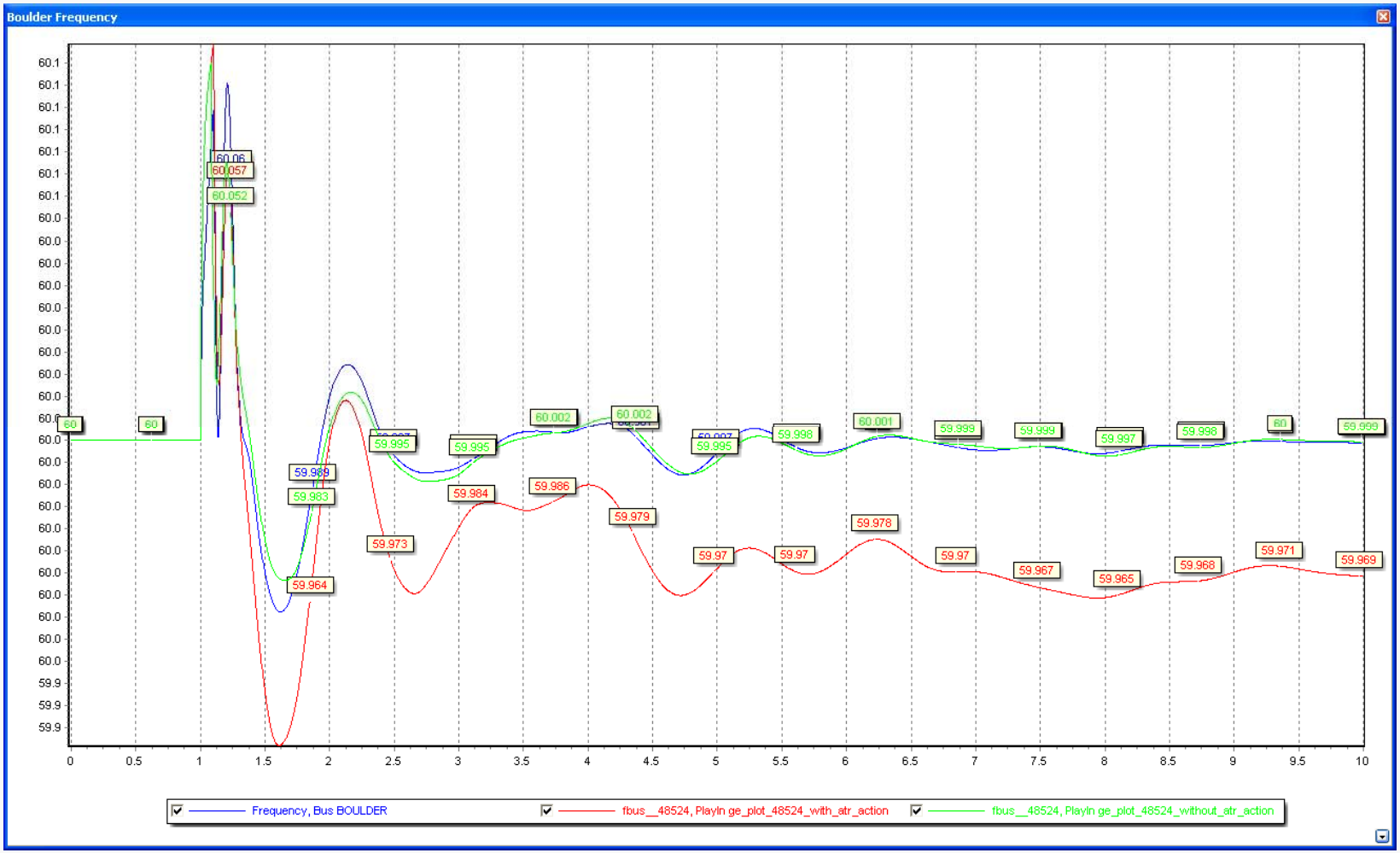


Compare Voltage

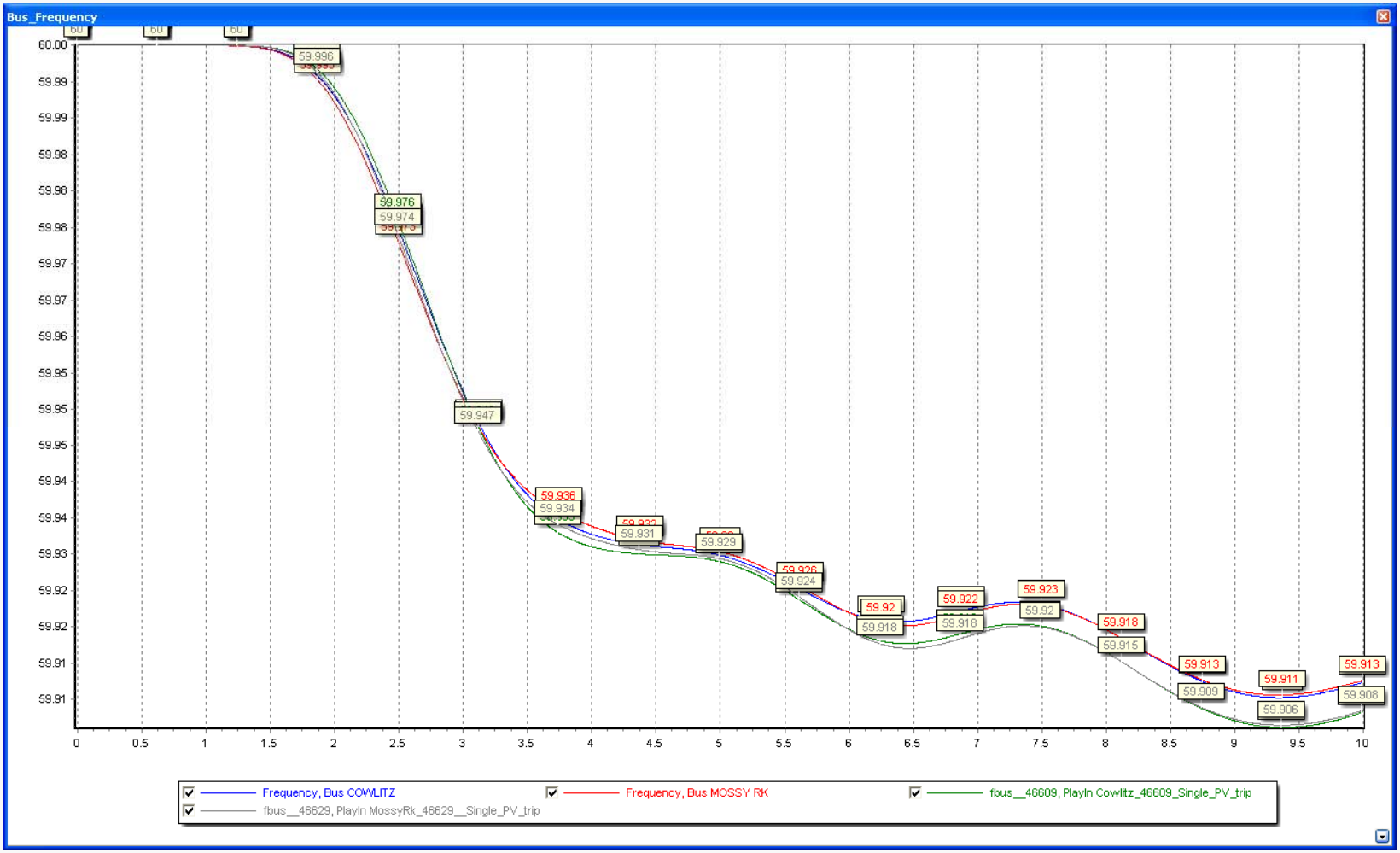


Compare Frequency

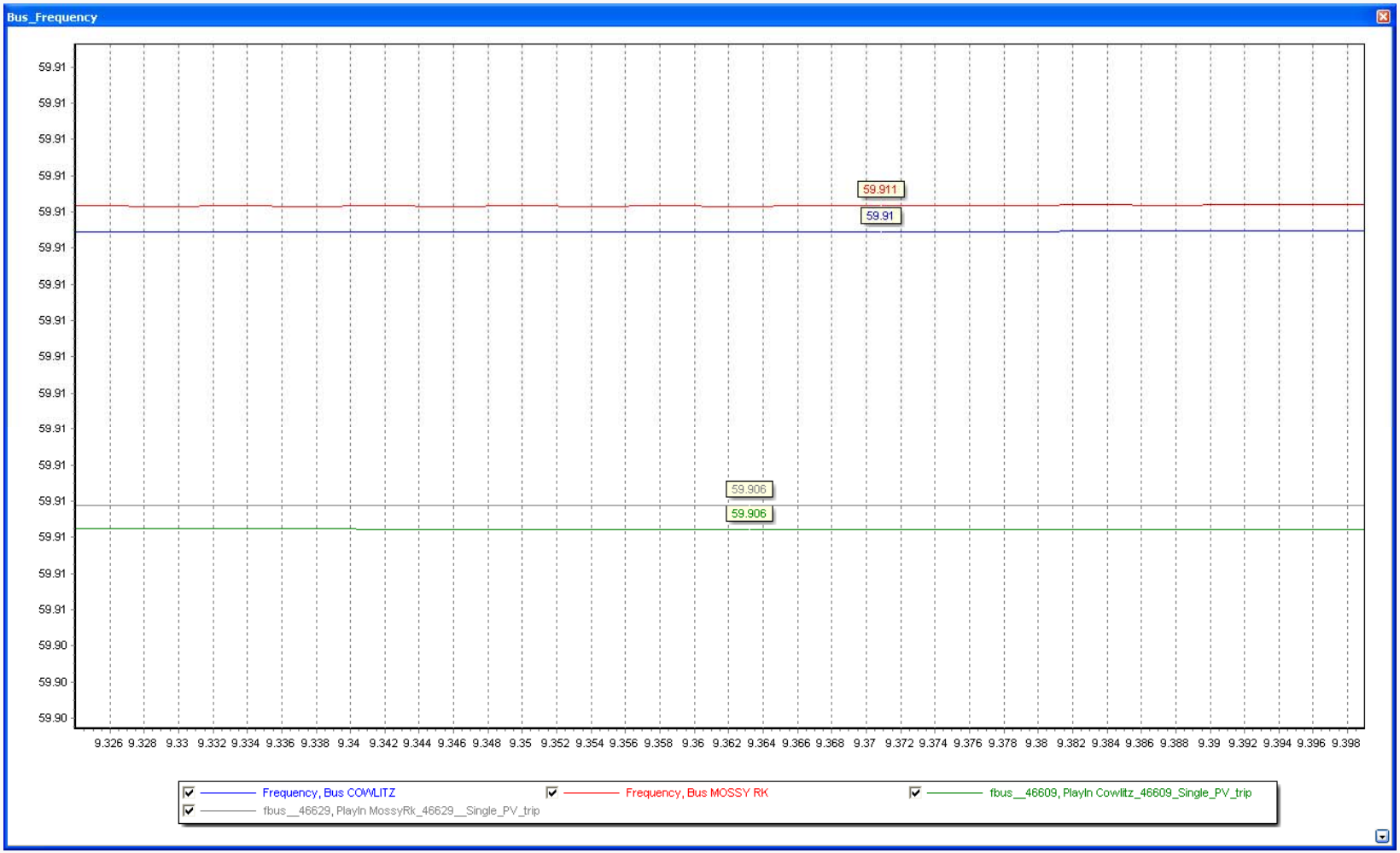
Note ATR effects on frequency



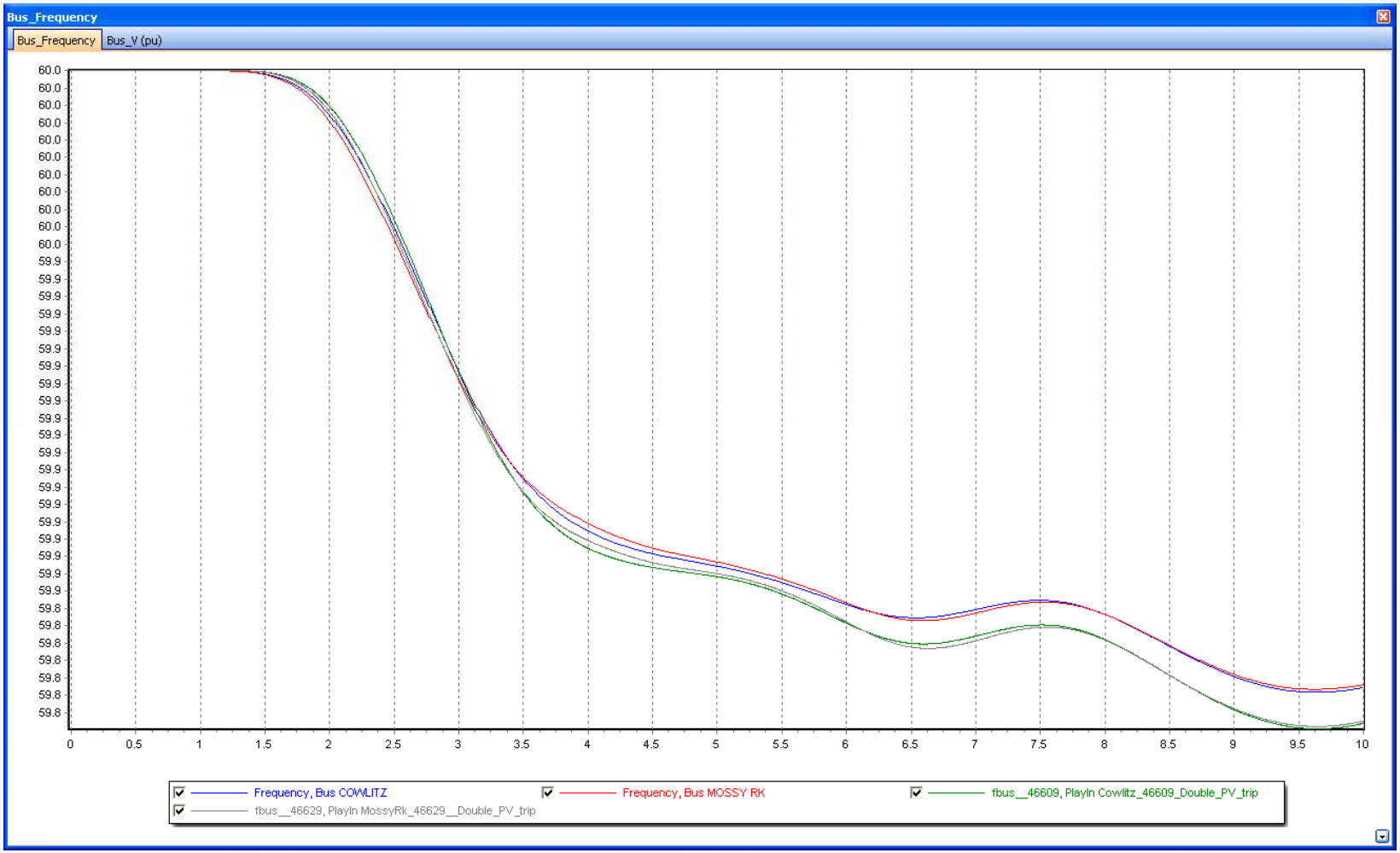
Single Palo Verde Compare (f)



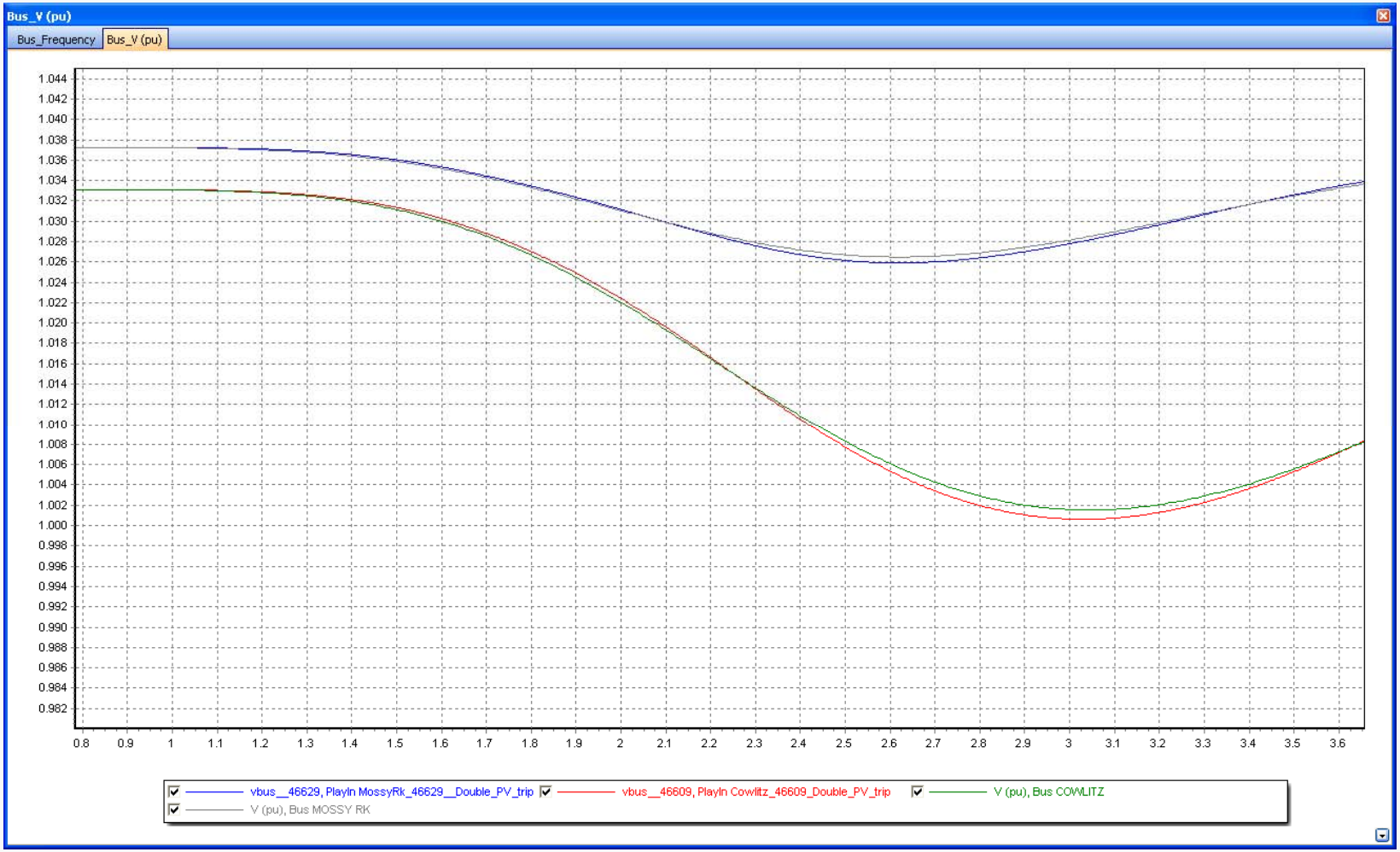
Zoomed In Single PV (f)



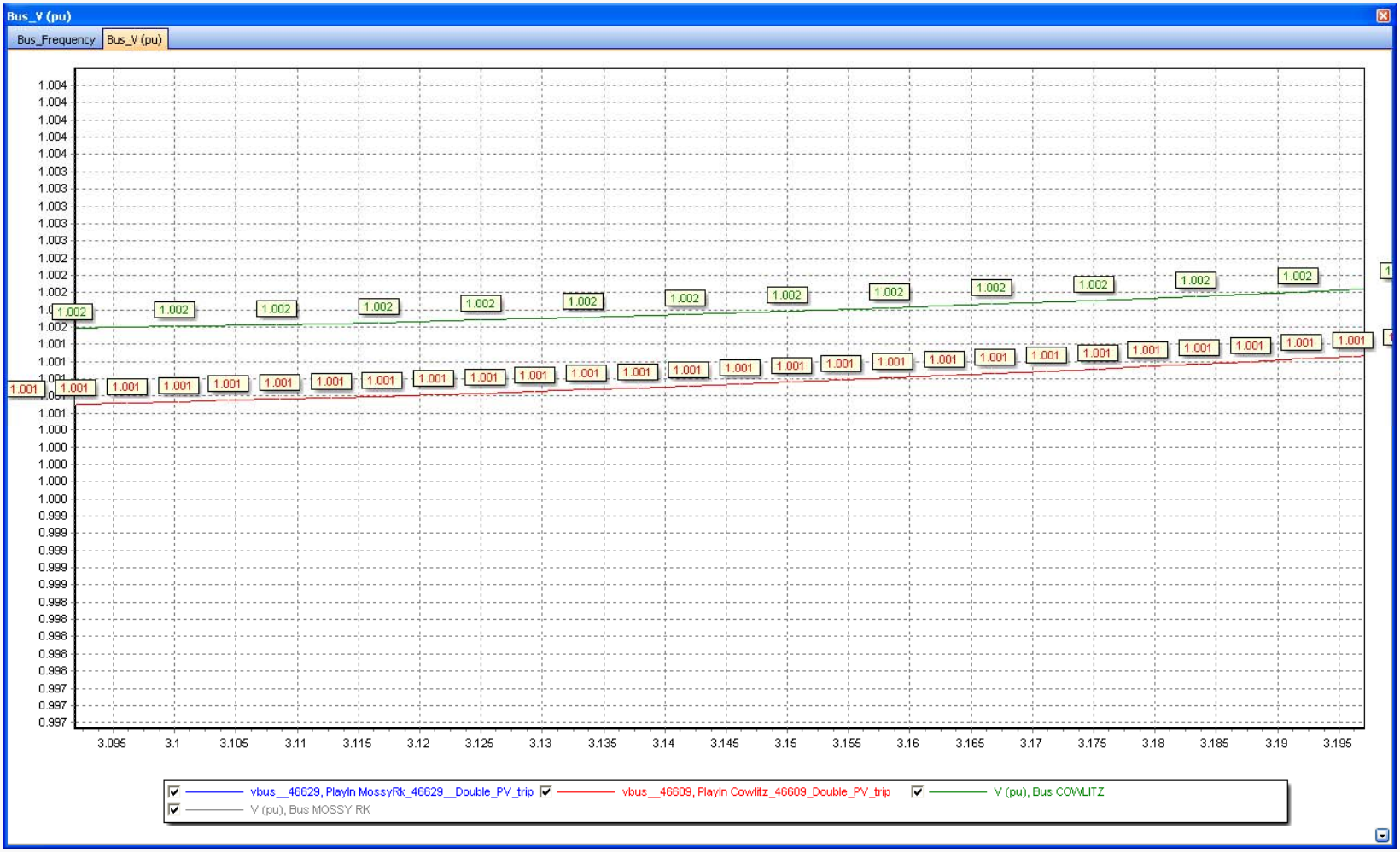
Double Palo Verde Compare (f)



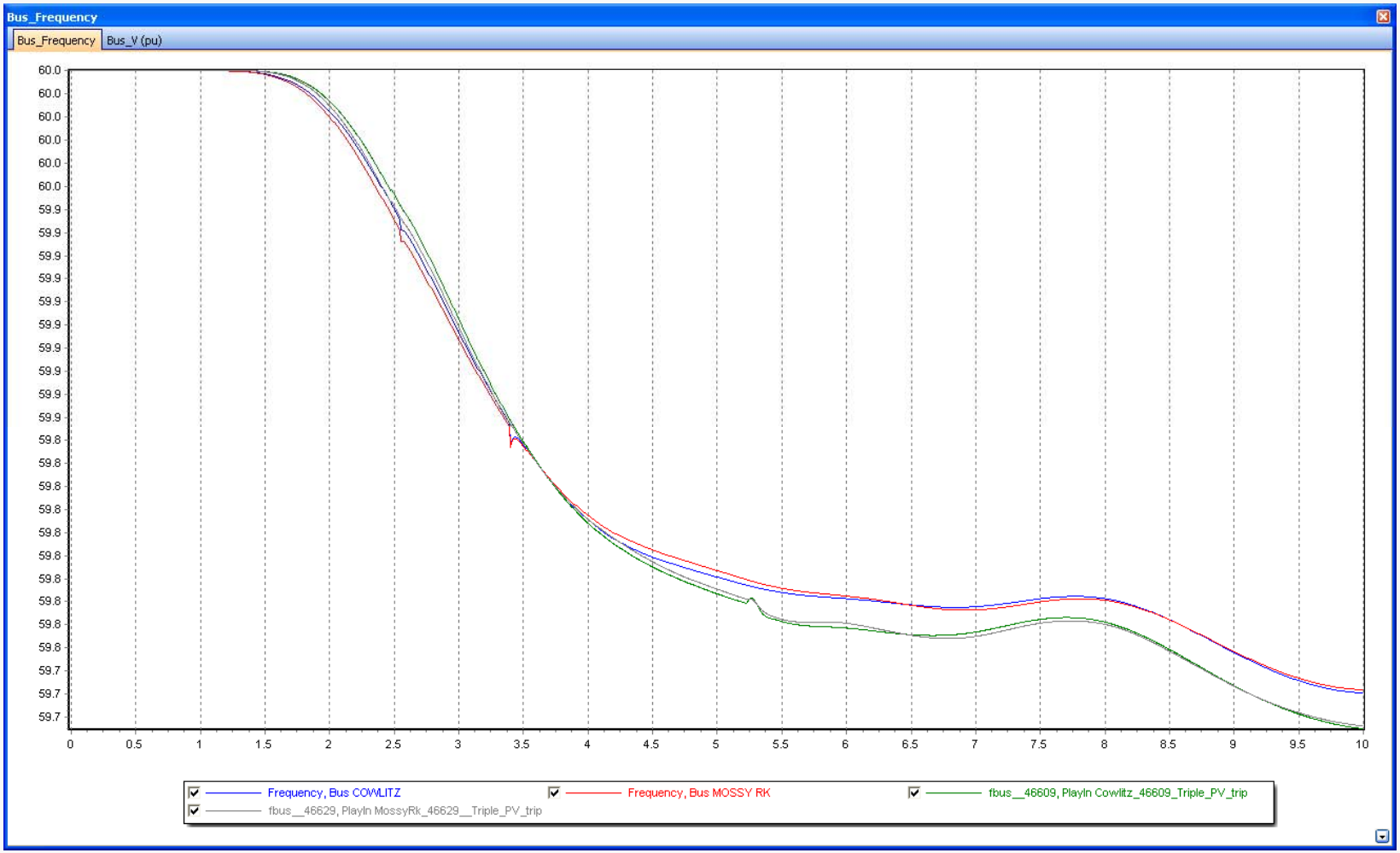
Double Palo Verde Compare (v)



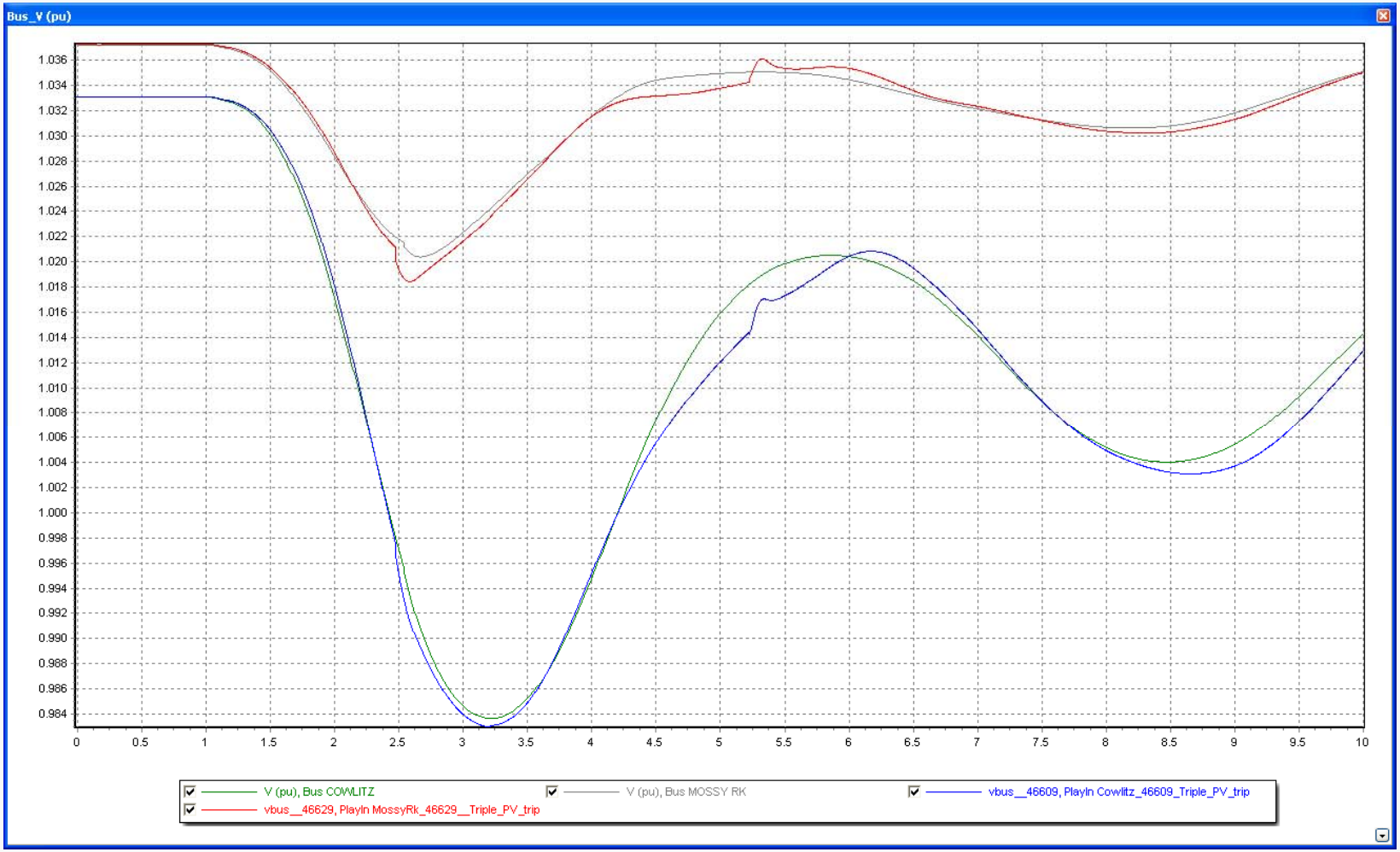
Zoomed In Double PV (v)



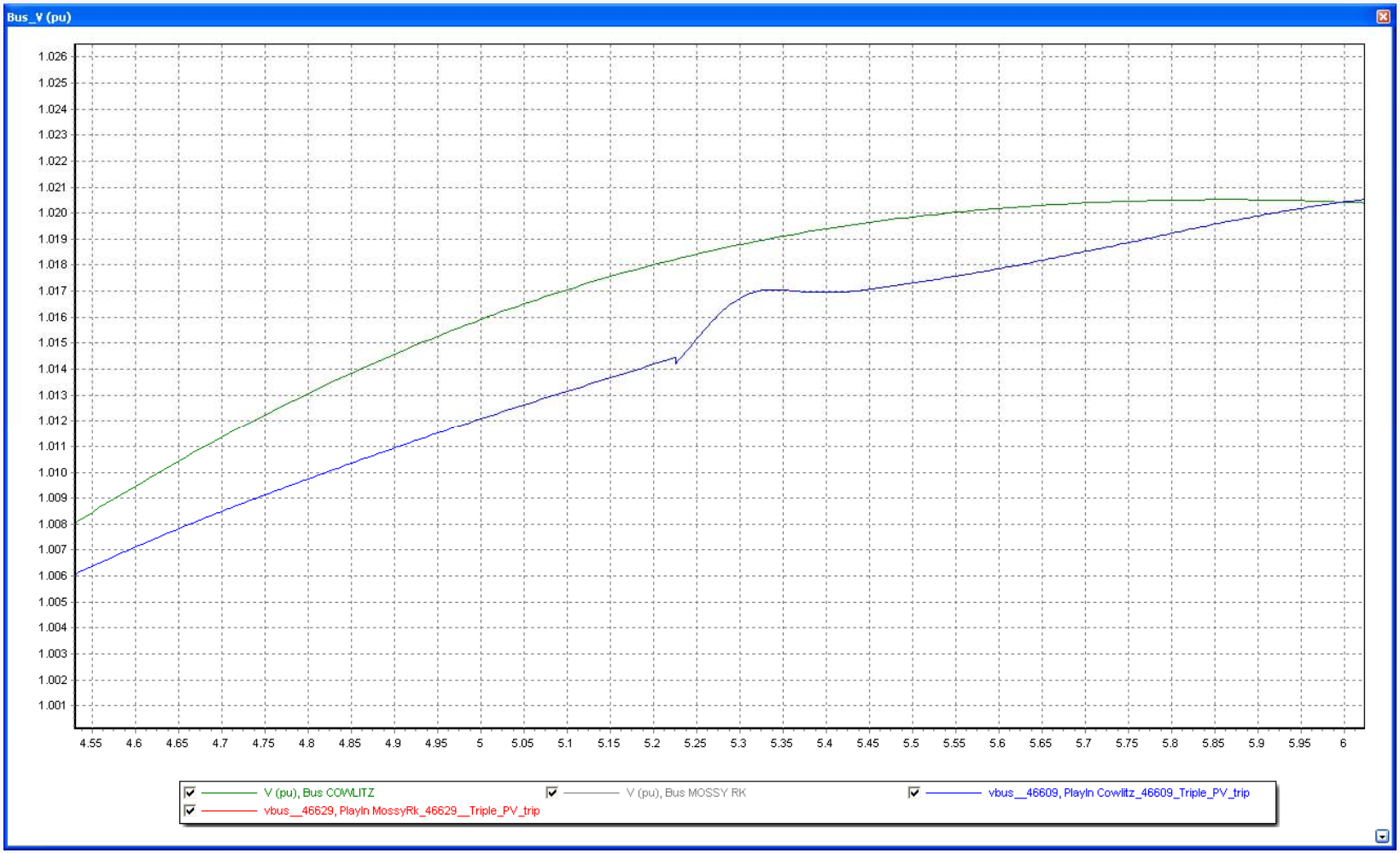
Triple Palo Verde Compare (f)



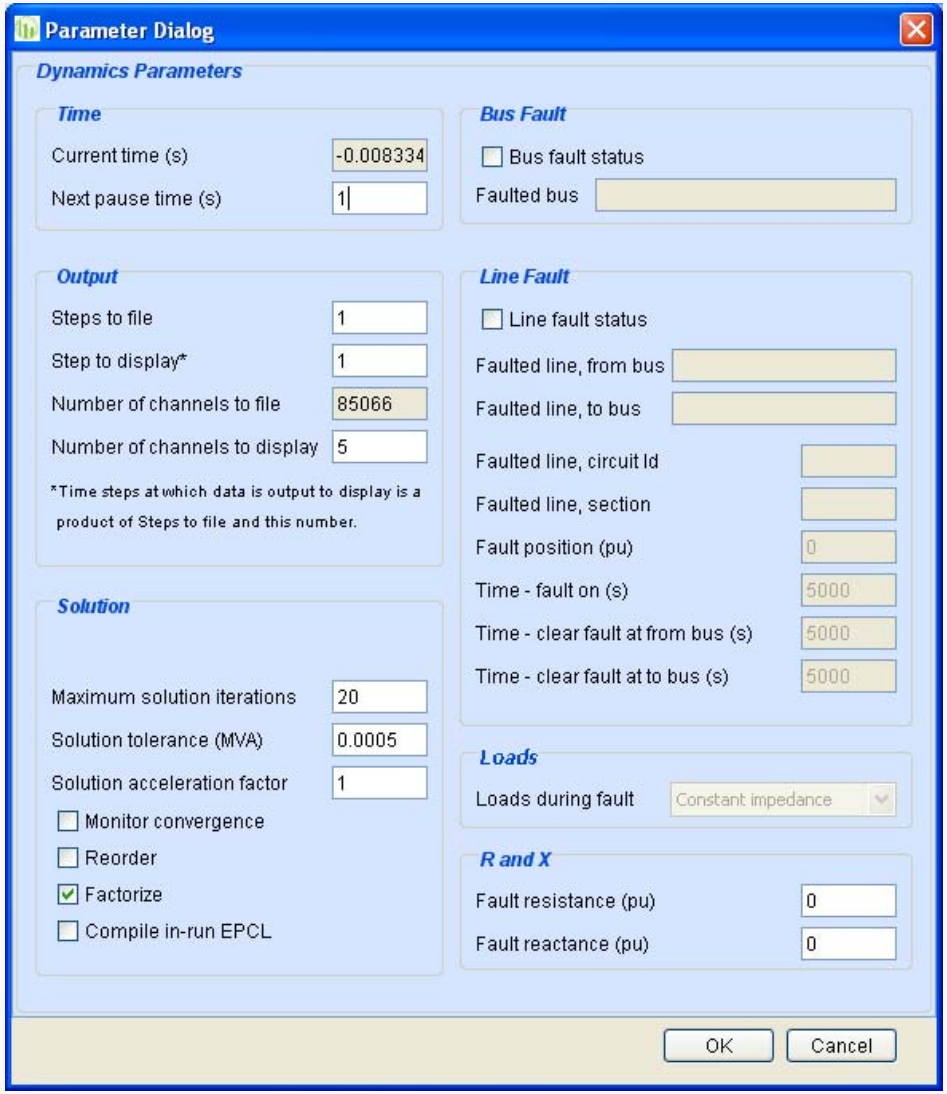
Triple Palo Verde Compare (v)



Zoomed In Triple PV (v)



Set GE for 1 & 1


Parameter Dialog
Dynamics Parameters
Time
Current time (s)
-0.008334
Next pause time (s)
1
Output
Steps to file
1
Step to display*
1
Number of channels to file
85066
Number of channels to display
5
*Time steps at which data is output to display is a product of Steps to file and this number.
Solution
Maximum solution iterations
20
Solution tolerance (MVA)
0.0005
Solution acceleration factor
1
Monitor convergence
Reorder
Factorize
Compile in-run EPCL
Bus Fault
Bus fault status
Faulted bus
Line Fault
Line fault status
Faulted line, from bus
Faulted line, to bus
Faulted line, circuit Id
Faulted line, section
Fault position (pu)
0
Time - fault on (s)
5000
Time - clear fault at from bus (s)
5000
Time - clear fault at to bus (s)
5000
Loads
Loads during fault
Constant impedance
R and X
Fault resistance (pu)
0
Fault reactance (pu)
0
OK
Cancel

GE vs PWS Assessment

- Adequate for Production
- Small Differences WILL Matter
  - 0.86 vs 0.87 separates Alberta via TLIN1
- Comparison Benefits GE and PWC
  - Both software packages are improved
- Thought required to test on the “same ground”