Modular Composite Load Model Implementation in WECC Base Case Update

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Modular Composite Load Model Creation Tool

- Andreas Schmitt (BPA) built a python script that imports the original spreadsheet (WECC Load Composition Model - ver4c.xlsx) data into the modular format
- Current version creates models that have the same parameters, although the format looks very different
- The goal in this testing is to confirm we are getting the same models from the tools and that PSLF is providing the same responses for modular and non-modular models
- Currently, the modular models are available in the following software versions:
  - Power World Simulator
  - PSLF v23 and v24 support the models, but only v24 new GUI has a high enough model limit to support models for a full WECC base case
  - PSS/e — available in v36, recommended that users move to v36.3.2, as there was a bug in earlier versions. Siemens is building the WECC dynamics cases with the modular composite load model in this version now

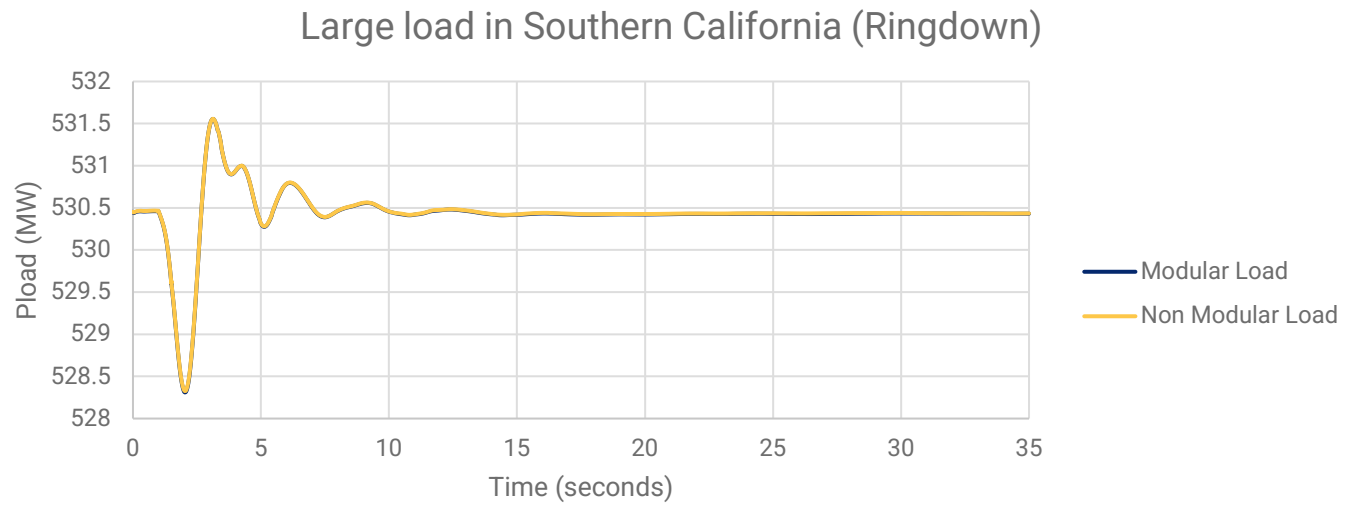
Model Examples

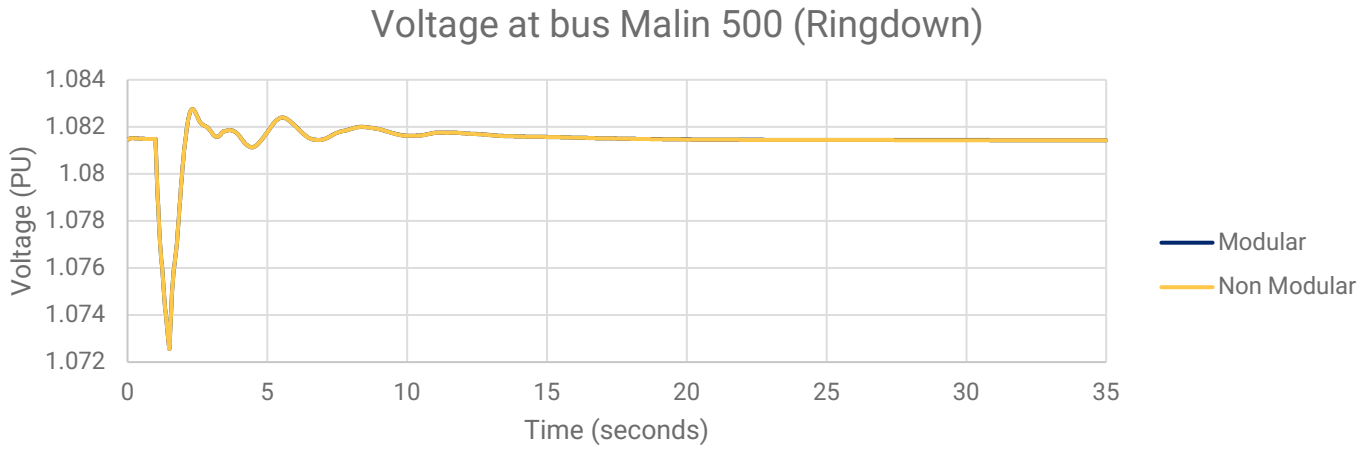
```
_cmpldw -47 "SCI_RES" 0 : #1.0  mva=-1.2 /
    "Pmin"  5.0  "PQmin"  1.4327  "Vmin"  0.93  "kVtresh"  40.0  /
    "Bss"     0.0  "Rfdr"    0.04   "Xfdr"  0.04  "Fb"  0.75  /
    "Xxf" 0.08  "TfixHS" 1.0  "TfixLS" 1.0  "LTC" 1.0  "Tmin" 0.9  "Tmax" 1.1  "step" 0.00625  /
    "Vmin" 1.0  "Vmax" 1.02  "Tdel" 999.0  "Ttap" 5.0  "Rcomp" 0.0  "Xcomp" 0.0   /
    "Fma"  0.0307574273867  "Fmb"  0.0428215894412  "Fmc"  0.0354693401701  "Fmd"  0.0483745648693  "Fel"  0.207617351522  /
    "PFel"  1.0   "Vd1"  0.7   "Vd2"  0.5   "Frcel"  1.0  /
    "pfs"  -0.999846544287   "P1e"  2   "P1c"  0.849183444522   "P2e"  1   "P2c"  0.150816555478   "Pfreq"  0.0  /
           "Q1e"  2   "Q1c"  -0.5   "Q2e"  1   "Q2c"  1.5   "Qfreq"  -1.0  /
    "MtpA"  3   "MtpB"  3   "MtpC"  3   "MtpD"  1  /
    "Lfm"  0.75   "Rs"  0.04   "Ls"  1.8   "Lp"  0.12   "LppA"  0.104  /
    "Tpo"  0.095   "Tppo"  0.0021   "H"  0.1   "etrq"  0.0  /
    "Vtr1"  0.7   "Ttr1"  0.1   "Ftr1"  0.2   "Vrc1"  1.0   "Trc1"  99999.0  /
    "Vtr2"  0.5   "Ttr2"  0.02   "Ftr2"  0.7   "Vrc2"  0.7   "Trc2"  0.1  /
    "Lfm"  0.75   "Rs"  0.03   "Ls"  1.8   "Lp"  0.19   "LppA"  0.14  /
    "Tpo"  0.2   "Tppo"  0.0026   "H"  0.5   "etrq"  2.0  /
    "Vtr1"  0.6   "Ttr1"  0.02   "Ftr1"  0.2   "Vrc1"  0.75   "Trc1"  0.05  /
    "Vtr2"  0.5   "Ttr2"  0.02   "Ftr2"  0.3   "Vrc2"  0.65   "Trc2"  0.05  /
    "Lfm"  0.75   "Rs"  0.03   "Ls"  1.8   "Lp"  0.19   "LppA"  0.14  /
    "Tpo"  0.2   "Tppo"  0.0026   "H"  0.1   "etrq"  2.0  /
    "Vtr1"  0.65   "Ttr1"  0.02   "Ftr1"  0.2   "Vrc1"  1.0   "Trc1"  9999.0  /
    "Vtr2"  0.5   "Ttr2"  0.02   "Ftr2"  0.3   "Vrc2"  0.65   "Trc2"  0.1  /
    "LfmD"  1.0   "CompPF"  0.98  /
    "Vstall"  0.45   "Rstall"  0.1   "Xstall"  0.1   "Tstall"  0.032   "Frst"  0.2   "Vrst"  0.95   "Trst"  0.3  /
    "fuvr"  0.1   "vtrl"  0.6   "ttrl"  0.02   "vtr2"  0.0   "ttr2"  9999.0  /
    "Vcloff"  0.5   "Vc2off"  0.4   "Vclon"  0.6   "Vc2on"  0.5  /
    "Tth"  15.0   "Th1t"  0.7   "Th2t"  1.9   "tv"  0.025  /
    "DGtype"  2  "dgdatno"  -110.0  "dgmbase"  -0.9


#SCI_RES
_cmp_stat  -100136  :  "pfs"  -0.9998465442871708   "P1e"  2   "P1c"  0.8491834445216279   "P2e"  1   "P2c"  0.15081655547837214   "Pfreq"  0.0 "Q1e"  2   "Q1c"  -0.49999999999999994   "Q2e"  1   "Q2c"  1.5   "Qfreq"  -1.0
_cmp_dist  -100095  :  "bss" 0.0 "rfdr" 0.040000 "xfdr" 0.040000 "xxf" 0.080000 "tfixhs" 1.000000 "tfixls" 1.000000 "ltc" 1.000000 "tmin" 0.900000 "tmax"   1.1000 "step" 0.006250 /
 "vmin" 1.000 "vmax"   1.0200 "tdel"  999     "ttap"   5.0000 "rcmp" 0.0 "xcmp" 0.0 "s1" 0.0 "s12" 0.0
_cmp_mot3  -100488  :  "lfm" 0.750000 "Ra" 0.040000 "Ls"   1.8000 "Lp" 0.120000 "Lpp" 0.104000 "Tpo" 0.095000 "Tppo" 0.002100 "H" 0.100000 "Etrq" 0.0 "Vtr1" 0.700000 /
 "Ttr1" 0.100000 "Ftr1" 0.200000 "Vrc1" 1.000000 "Trc1" 99999.00 "Vtr2" 0.500000 "Ttr2" 0.020000 "Ftr2" 0.700000 "Vrc2" 0.700000 "Trc2" 0.100000
_cmp_mot3  -100688  :  "lfm" 0.750000 "Ra" 0.030000 "Ls"   1.8000 "Lp" 0.190000 "Lpp" 0.140000 "Tpo" 0.200000 "Tppo" 0.002600 "H" 0.500000 "Etrq"   2.0000 "Vtr1" 0.600000 /
 "Ttr1" 0.020000 "Ftr1" 0.200000 "Vrc1" 0.750000 "Trc1" 0.050000 "Vtr2" 0.500000 "Ttr2" 0.020000 "Ftr2" 0.300000 "Vrc2" 0.650000 "Trc2" 0.050000
_cmp_mot3  -100888  :  "lfm" 0.750000 "Ra" 0.030000 "Ls"   1.8000 "Lp" 0.190000 "Lpp" 0.140000 "Tpo" 0.200000 "Tppo" 0.002600 "H" 0.100000 "Etrq"   2.0000 "Vtr1" 0.650000 /
 "Ttr1" 0.020000 "Ftr1" 0.200000 "Vrc1" 1.000000 "Trc1"  9999.00 "Vtr2" 0.500000 "Ttr2" 0.020000 "Ftr2" 0.300000 "Vrc2" 0.650000 "Trc2" 0.100000
_cmp_lpac  -100988  :  "lfm" 1.000000 "CompPF" 0.980000 "Vstall" 0.450000 "Rstall" 0.100000 "Xstall" 0.100000 "Tstall" 0.032000 "Frst" 0.200000 "Vrst" 0.950000 "Trst" 0.300000 "fuvr" 0.100000 /
 "vtrl" 0.600000 "ttr1" 0.020000 "vtr2" 0.0 "ttr2"  9999.00 "Vcloff" 0.500000 "Vc2off" 0.400000 "Vclon" 0.600000 "Vc2on" 0.500000 "Tth"  15.0000 "Th1t" 0.700000 /
 "Th2t"   1.9000 "Tv" 0.025000
_cmp_elec  -100287  :  "pfel" 1.000000 "vd1" 0.700000 "vd2" 0.500000 "frcel" 1.000000
_cmp_der_a  -110  :  "trv" 0.020000 "dbd1" -99.0000 "dbd2"  99.0000 "kqv" 0.0 "vref0" 0.0 "tp" 0.020000 "pfflag" 1.000000 "tiq" 0.020000 "ddn"  20.0000 "dup"  20.0000 /
 "fdbd1" -0.000600 "fdbd2" 0.000600 "femax"  99.0000 "femin" -99.0000 "pmax" 1.000000 "pmin" 0.0 "frqflg" 1.000000 "dPmax"  99.0000 "dPmin" -99.0000 "tpord"   5.0000 /
 "imax"   1.2000 "pqflag" 0.0 "vl0" 0.490000 "vl1" 0.540000 "vh0"   1.2000 "vh1"   1.1500 "tvl0" 0.160000 "tvl1"   1.5000 "tvh0" 0.160000 "tvh1"   1.5000 /
 "vrfrac" 0.500000 "fltrp"  58.5000 "fhtrp"  61.2000 "tfl"   300.00 "tfh"   300.00 "tg" 0.020000 "rrpwr"   2.0000 "tv" 0.020000 "kpg" 0.100000 "kig"  10.0000 /
 "xe" 0.250000 "typeflag" 1.000000 "vfth" 0.300000 "iqh1" 1.000000 "iql1" -1.000000
_cmpldw2  -38 "SCI_RES" 0  : #1 mva=-1.2   /
 "Pmin" 5 "PQmin" 1.4327 "Vmin" 0.93 "kVtresh" 40 /
     cmp_dist  -100095 /
     cmp_mot3  -100488  0.030757427386701095 /
     cmp_mot3  -100688  0.0428215894411671 /
     cmp_mot3  -100888  0.035469340170121384 /
     cmp_lpac  -100988  0.0483745648693237 /
     cmp_elec  -100287  0.20761735152248598 /
     cmp_der_a  -110  1  -0.900 /
     cmp_stat  -100136  -1
```

Note: the only difference is the removal of the Fb parameter as it is assumed to be 1 in the modular model

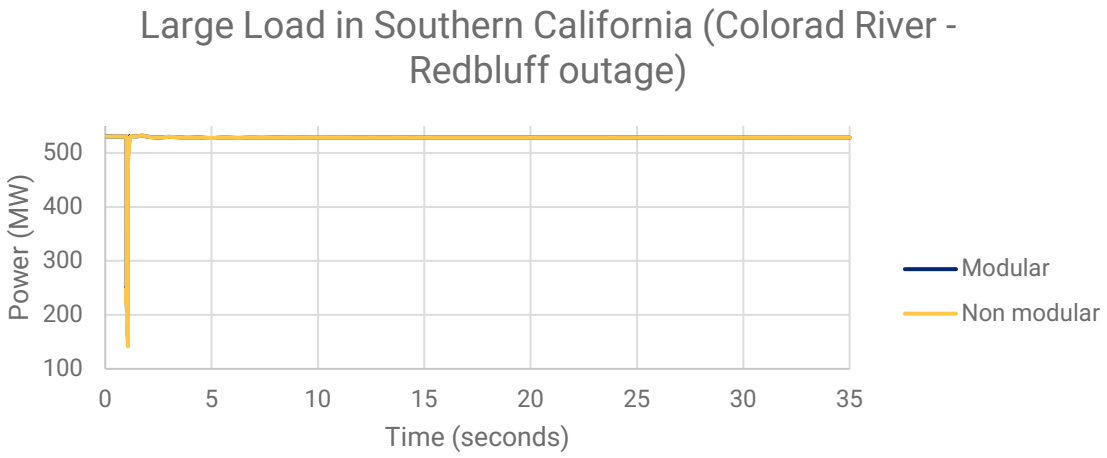
Test with Ringdown

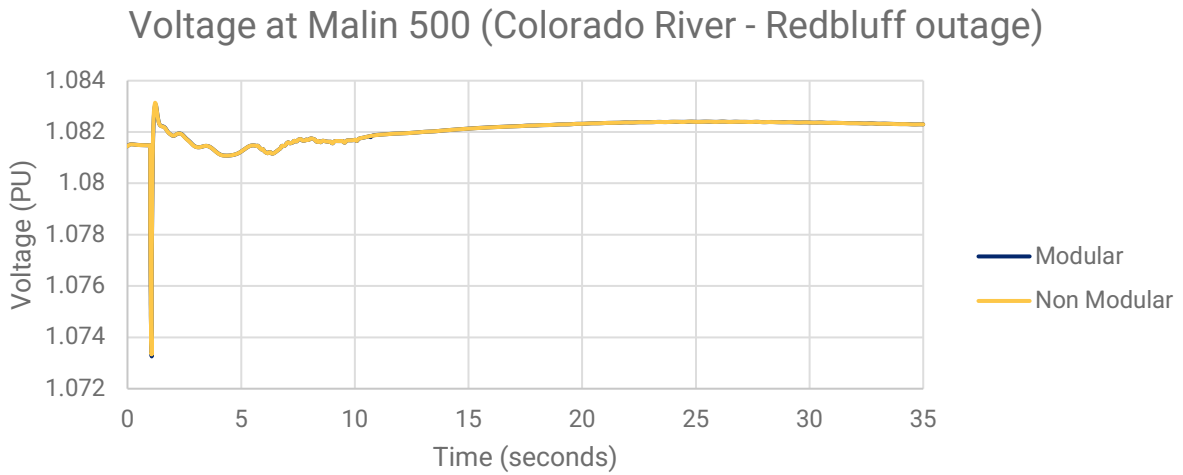




Colorado River — Redbluff Outage

Four-cycle, three-phase fault at the Colorado River 500 kV bus. The fault is cleared, and the two circuits from Colorado River to Redbluff are tripped





Colorado River — Redbluff: Load Tripped by Composite Load Model

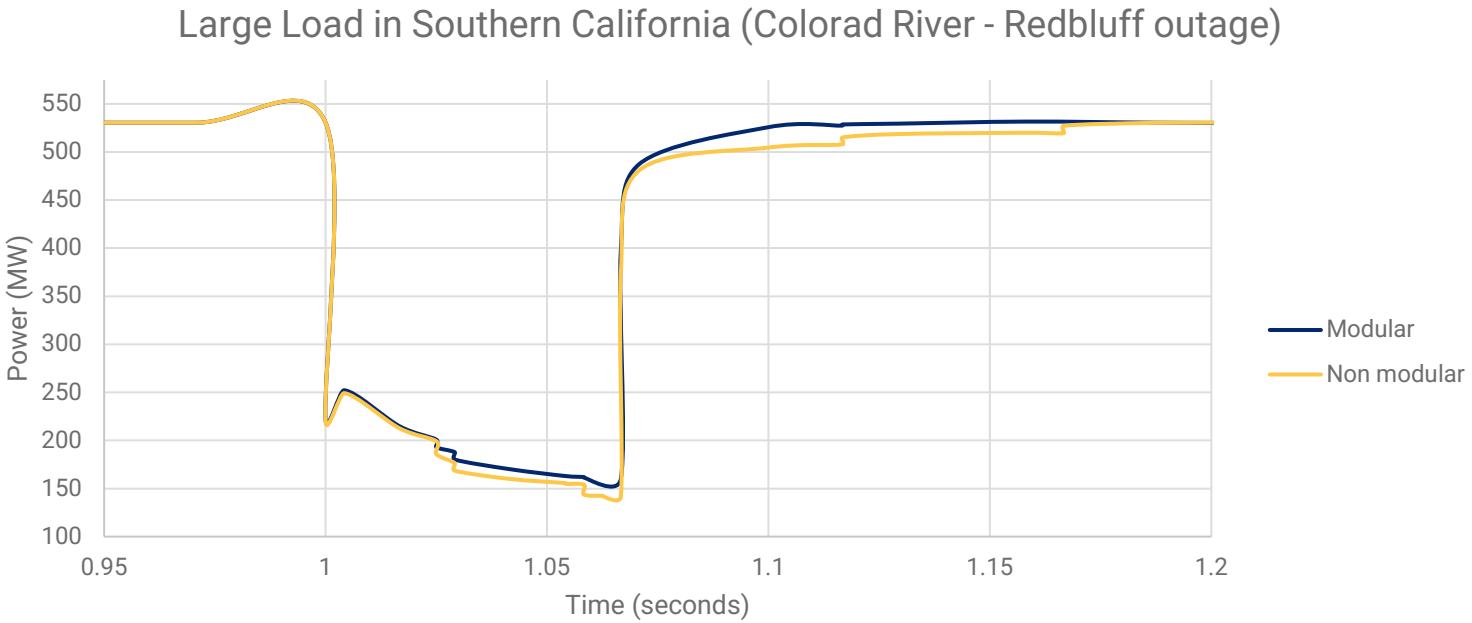
Modular

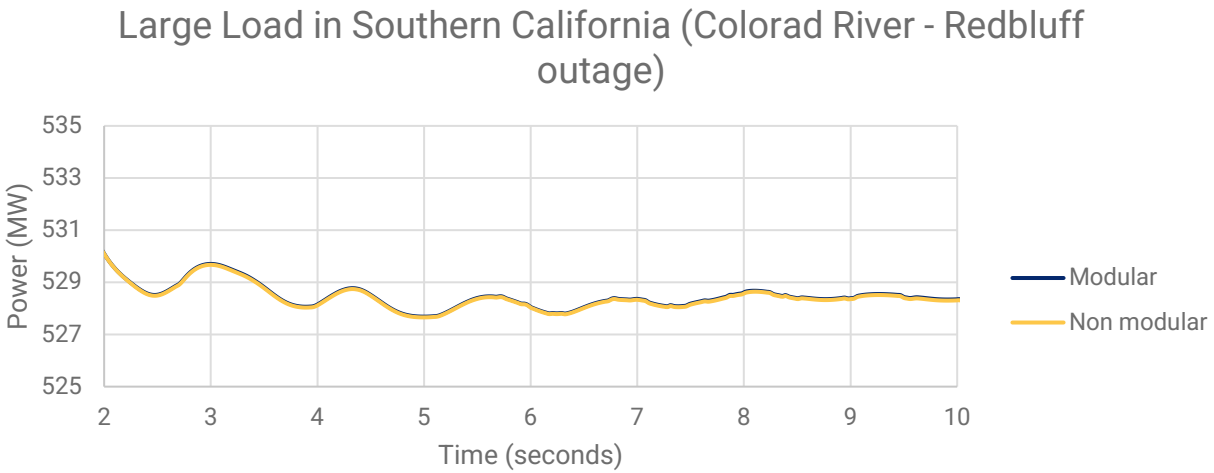
To Bus	To Bus Name	Type	Model Name	Area	Max. Value	Final - Init.	Final Value	Min. Time	Max. Time	Spread	Spread %	Up Spread	Down Spread
21	IID	xton	ldtrpmo2	21	4.9351	0	0	0.033	1.067	4.935	0	4.935	0
24	SOCALIF	xton	ldtrpmo2	24	246.9077	16.42287	16.42287	0.033	1.067	246.908	0	246.908	0

Non-Modular

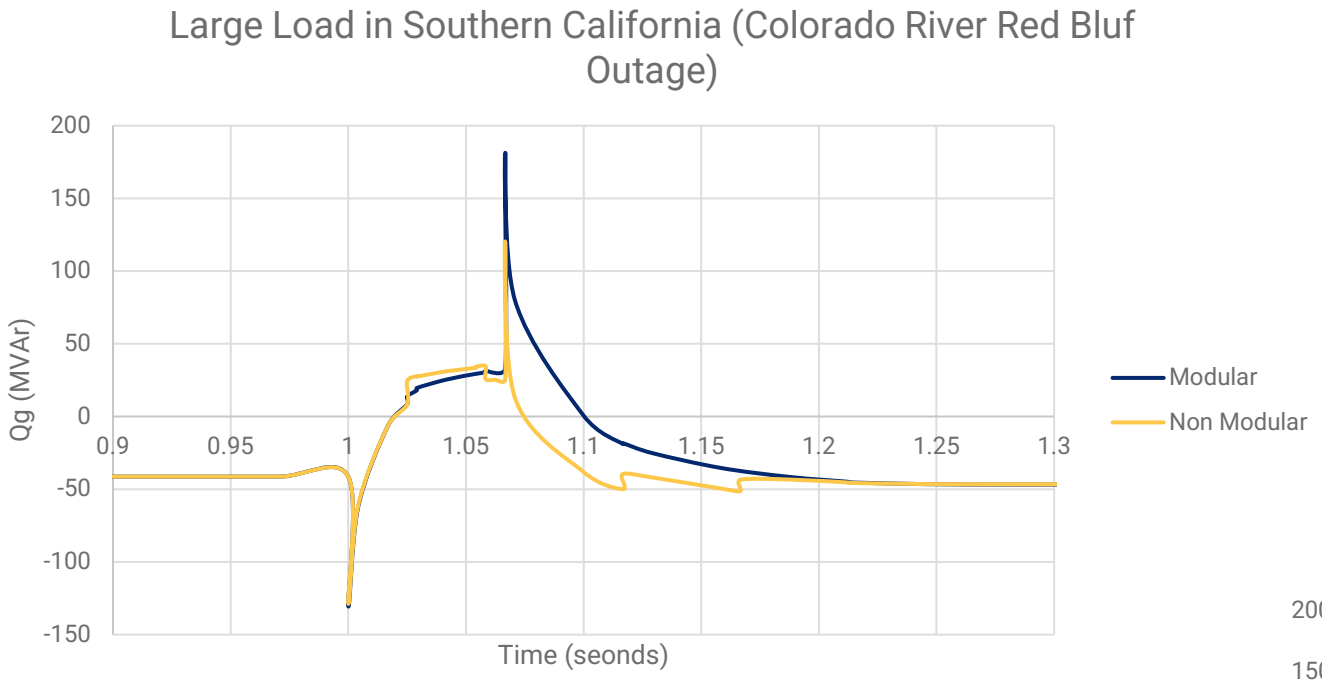
To Bus	To Bus Name	Type	Model Name	Area	Max. Value	Final - Init.	Final Value	Min. Time	Max. Time	Spread	Spread %	Up Spread	Down Spread
21	IID	xton	ldtrpmon	21	6.03231	0	0	0.033	1.067	6.032	0	6.032	0
24	SOCALIF	xton	ldtrpmon	24	277.3065	16.43945	16.43945	0.033	1.067	277.307	0	277.307	0

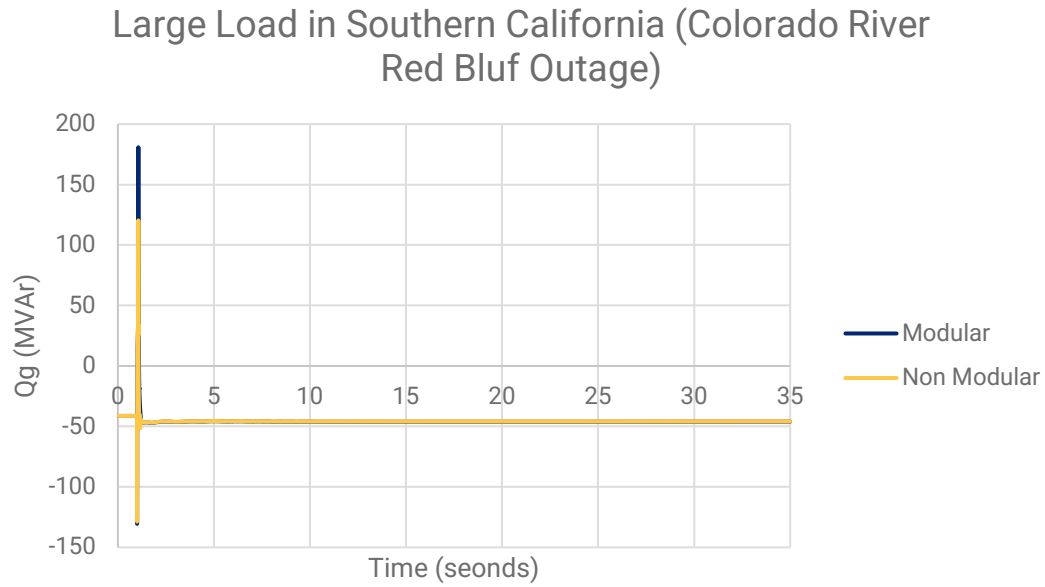
Colorado River — Redbluff: Load Details



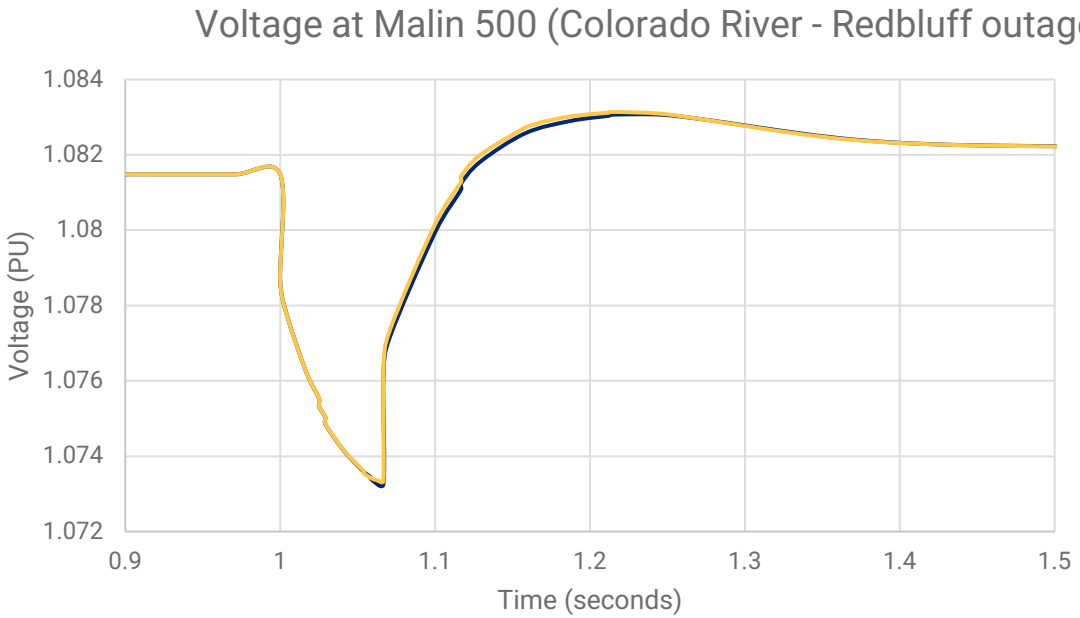


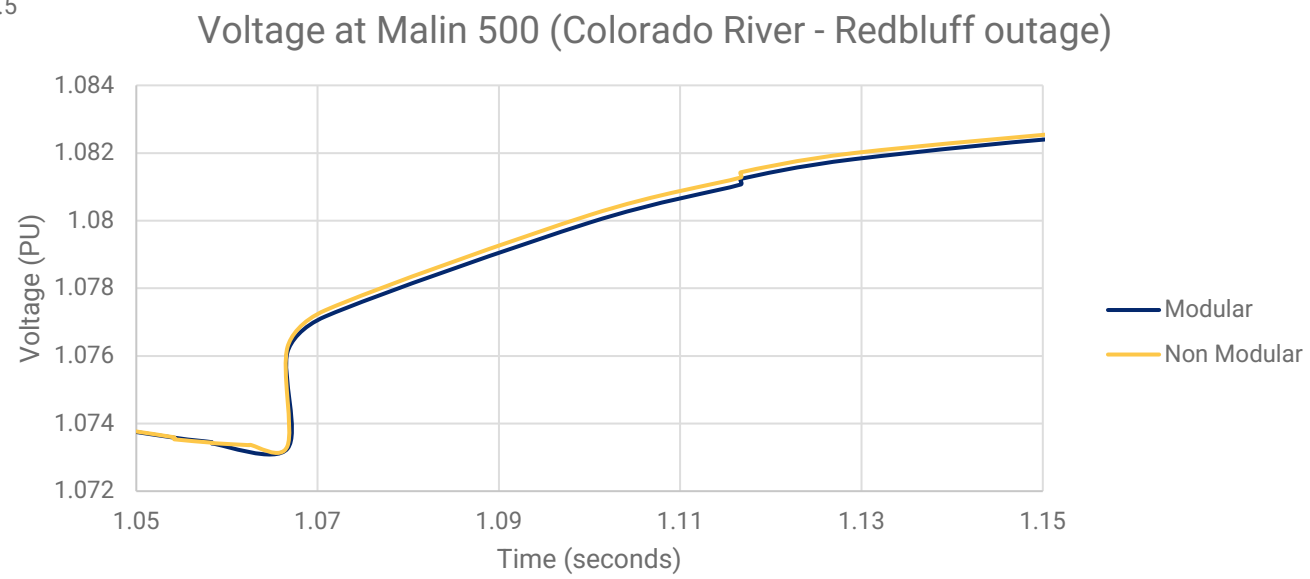
Colorado River —Redbluff: Load Details, Continued





Colorado River — Redbluff: Bus Voltage Details





Question for MVS

- Are there concerns with these differences?
- If not, are there concerns with implementing them in the WECC base cases?

WECC

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